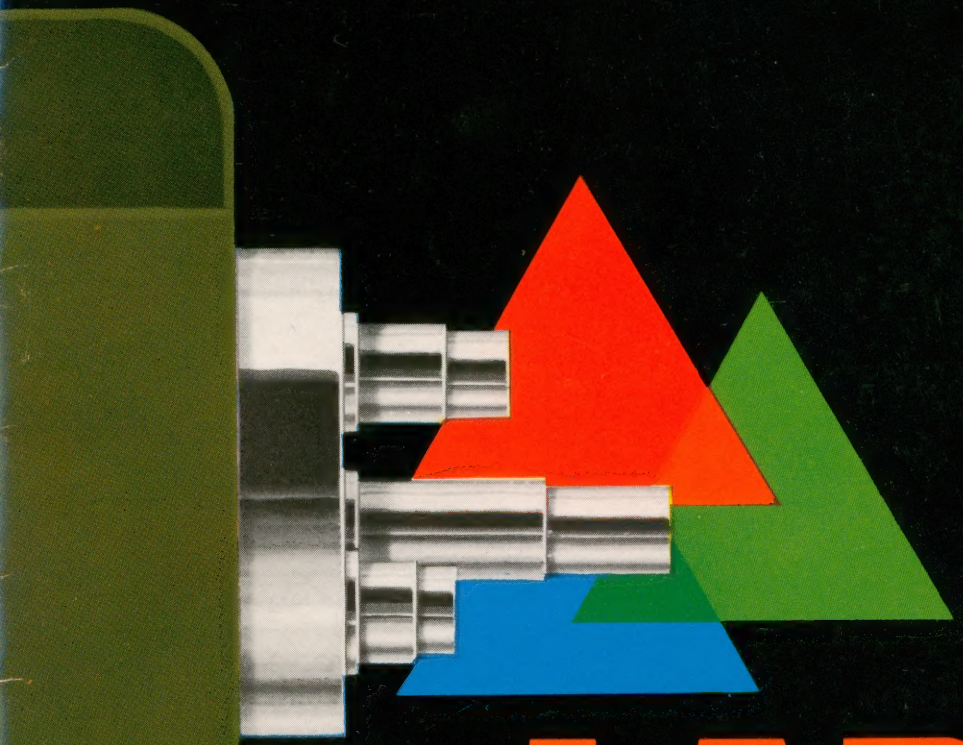

Supplement to
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LARGE SCREEN

COLOR RECEIVER

RCA SERVICE COMPANY, INC.
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LARGE SCREEN

COLOR RECEIVER

RCA Service Company, Inc. A RADIO CORPORATION OF AMERICA SUBSIDIARY

RCA VICTOR COLOR TELEVISION RECEIVER

MODEL 21CT662

THE *DIRECTOR*

SECTION I

Description of the RCA 21" Color Kinescope and Related Accessories

THE RCA 21" color kinescope (21AXP22) is composed of the following major components:

1. Phosphor dot viewing screen
2. Shadow mask
3. Three electron gun assembly
4. Envelope

Accessories used with the 21" color kinescope are:

1. Convergence assembly
2. Blue lateral magnet
3. Purifying magnet
4. Color equalizer assembly
5. Deflecting yoke

Phosphor Dot Screen

The phosphor dots of the 21" color kinescope are printed directly upon the back of the faceplate, which serves as the phosphor dot screen. Size of the phosphor dots has been increased only slightly over those in the 15GP22. Spacing between the centers of adjacent dot trios in the 21" tube is .029" as illustrated in FIGURE 1. This compares with the .024" spacing of the 15" color picture tube. The size of the phosphor dots has been kept small to insure that the colored dot pattern will not be visible at normal viewing distances. In the 21" picture tube, approximately one-million phosphor dots are used (357,000 trios).

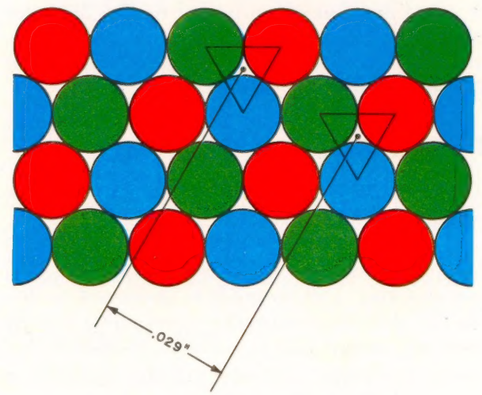


Figure 1 — Spacing of the Phosphor Dots

The faceplate of the 21" picture tube is rounded, having the curvature illustrated in FIGURE 2. This rounding of the phosphor dot screen tends to equalize the length of beam travel to different parts of the screen. When compared to the flat screen, this rounding simplifies the dynamic convergence requirements.

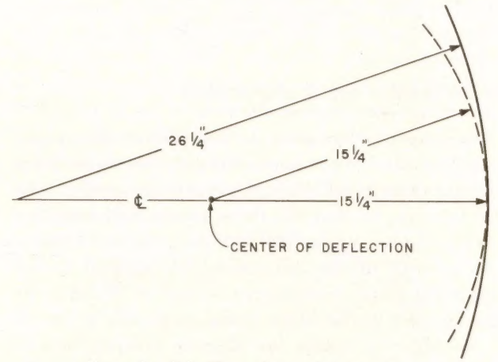


Figure 2 — Side View of Rounded Faceplate

Shadow Mask

The shadow mask of the 21" color tube has the approximate curvature of the faceplate so that the trio spacing is uniform over the entire screen area. The shadow mask contains approximately 357,000 holes or apertures through which the phosphor dot screen is scanned.

A change in alignment of the shadow mask and the phosphor dot screen due to heat expansion can result in color impurity. To maintain this alignment, the expansion of the shadow mask in the 21" picture tube is controlled as it heats. Temperature compensation of the shadow mask is provided by special design of the mask mounting ring. This compensation provides that, as the mask expands, apertures move in the direction of the beam travel and minimize change of alignment of dot trios and apertures.

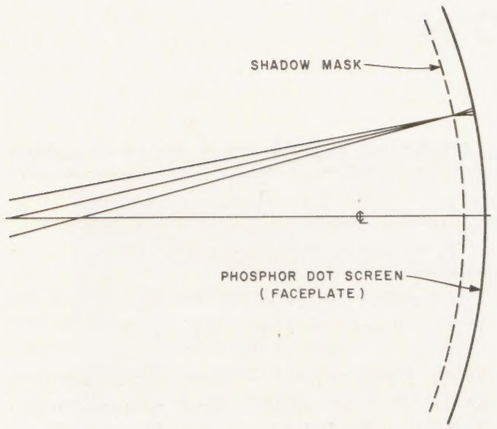


Figure 3 — Spacing of Shadow Mask and Phosphor Dot Screen

The Three Gun Assembly

The three electron guns are manufactured as a unit and mounted in the neck of the picture tube. Each of the three guns is tilted toward the central axis of the tube so that the three beams will converge at the shadow mask. This is illustrated in FIGURE 4. As a result of the mechanical tilt applied to the guns, the static convergence correction which must be applied to the three beams is greatly reduced.

In order to obtain the shortest possible overall picture tube length without greatly increasing the angle of deflection, the length of the electron gun assembly was made as short as possible. The gun assembly for the 21″ color tube was decreased approximately 2″ from that of the 15″ tube.

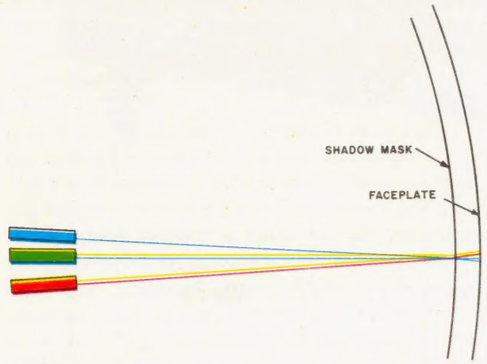


Figure 4 — Mechanical Tilt of the Three Electron Guns

Each of the electron guns is flanked by a pair of internal magnetic pole pieces. These direct the magnetic convergence fields to the area directly in front of the guns and they minimize interaction between guns. In addition, a separate internal pole piece, known as the blue lateral pole piece, is supplied for the blue gun. In all, there are four internal pole pieces in the electron gun assembly: one each for the red and green guns and two for the blue gun. These pole pieces are illustrated in FIGURE 5.

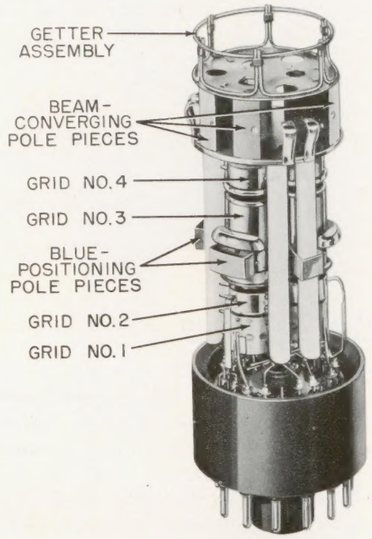


Figure 5 — Electron Gun Assembly

Envelope

A round metal envelope is used for the 21″ color picture tube. Total picture size of the 21AXP22 is 19-1/16″ x 15-1/4″. This provides a total area of 255 square inches.

Convergence Assembly

The convergence assembly and other accessories are mounted as shown in FIGURE 6.

The convergence assembly consists of three combination permanent-electro-magnets mounted on a common ring. This assembly is positioned so that the "U" shaped core of each magnet pair is directly over the internal pole pieces of its associated electron gun. Proper orientation of this assembly is pictured in FIGURE 7.

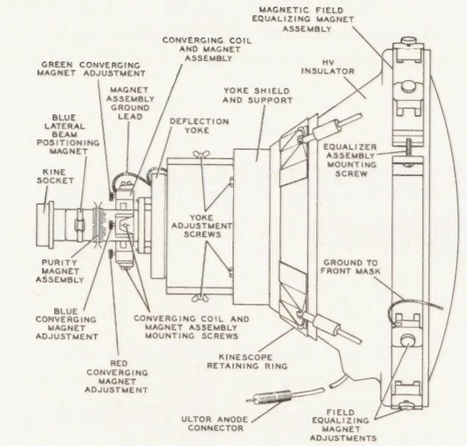


Figure 6 — 21″ Kinescope and Associated Accessories

When the convergence magnets are correctly positioned over the pole pieces, the field of each convergence magnet may be adjusted for proper convergence of its associated beam without seriously affecting the other two beams.

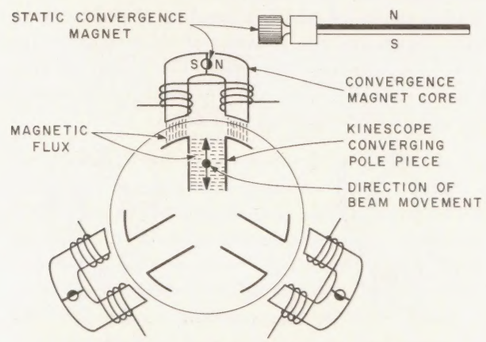


Figure 7 — Convergence Magnet Mounted Over Internal Pole Piece

Blue Lateral Magnet

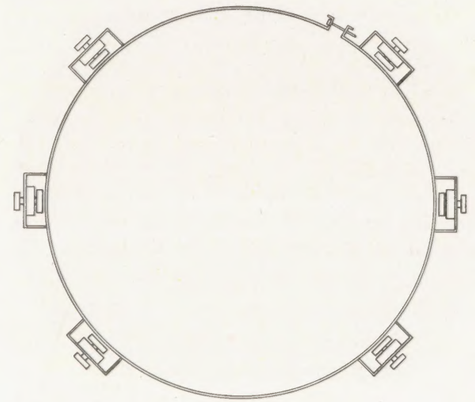
The blue lateral adjusting magnet is located over its associated pole piece at the rear of the tube neck as shown in FIGURE 6. This magnet is used, in conjunction with the permanent magnets of the convergence assembly, for adjusting static convergence.

Purifying Magnet

The purifying magnet is a permanent magnet and is mounted on the neck of the color picture tube directly behind the convergence assembly as illustrated in FIGURE 6. The field produced by this magnet affects all three beams equally and is adjusted for strength and direction which will cause the emitted beams to pass through their "centers of deflection." Strength of the purifying field is adjusted by separating the red tabs on the magnet assembly. When the red tabs are together there is no purifying field. Direction of the magnetic field is adjusted by rotating the entire assembly around the neck of the tube.

The Color Equalizer Assembly

As shown in FIGURE 8, the color equalizer assembly consists of six permanent magnets mounted around the front rim of the kinescope. The assembly is utilized to neutralize extraneous magnetic fields around the periphery of the kinescope. Each magnet is mounted in a high permeability keeper or housing, which acts to short circuit or remove its magnetic field when the magnet is retracted into it. Strengths of the individual magnetic fields applied to the picture tube may be increased by moving the magnets out of their housings toward the picture tube. The magnetic fields will then penetrate the



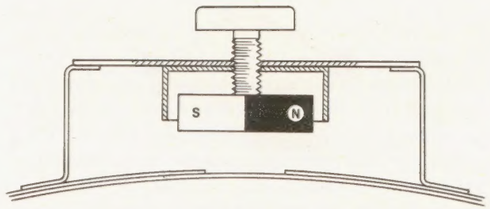


Figure 8 — Color Equalizer Assembly

outer areas of the picture tube. The effective direction of the magnetic lines of force within the picture tube is then adjusted by rotating the magnet in its holder. These magnets exhibit localized influence on color purity and are adjusted to correct for purity errors around the outside edge of the screen.

Operating Principles and Adjustment Procedure of the 21" Color Kinescope

Convergence

For correct color reproduction, it is necessary that the three beams meet or converge at the shadow mask and excite color dots of the same trios. The three guns are mechanically tilted toward the central axis of the tube so that virtual convergence is obtained with no external converging force applied. Slight bending of one or more of the beams may be required for exact convergence. The three permanent magnets of the convergence assembly and the blue lateral magnet provide magnetic fields which supply this extra bending, if required, for exact static convergence at the center of the screen.

If the alignment of the guns be such that the beams do not reach convergence by the time they pass through the aperture plate, it will be necessary to magnetically bend each toward the central axis of the tube. This is accomplished by selecting the orientation of each magnet (by rotating it in its holder) which will cause the beams to be bent inward. With the magnets so oriented, the blue beam will move along in a vertical line and across in a horizontal line and the red and green beams will move radially along lines spaced at 120 degrees from the blue vertical line of motion as indicated in FIGURE 9.

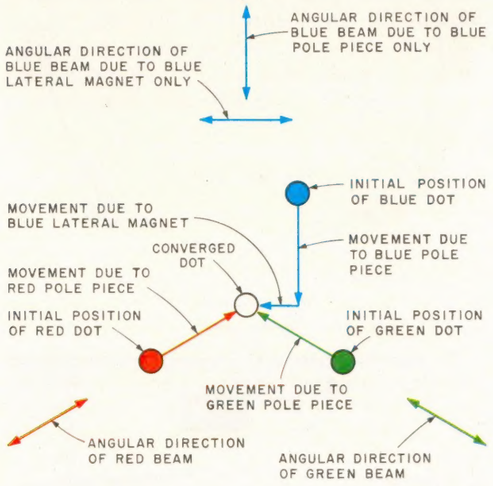


Figure 9 — Direction of Movement of the Red, Green and Blue Beams

The amount of such correction may be controlled by changing the alignment of these magnets in their cores. When the poles of one of these magnets are exactly aligned with the core, maximum force will be applied to the beam. If the magnet is turned so as to decrease this alignment, a smaller magnetic field is produced and less bending of the beam results. Reversing the polarity of these magnets results in an opposite correction. The beams are then bent toward the outer rim. The effect of rotation of the core is illustrated in FIGURE 10.

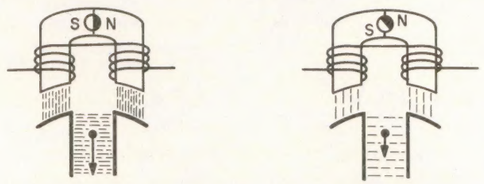


Figure 10 — Effect of Rotation of the Convergence Magnet

By adjusting the red and green magnets, the red and green beams can be made to exactly coincide at some point as shown in FIGURE 9. When this point is reached, it is then possible to place the blue beam on the same horizontal line with the overlapped green and red by adjusting its convergence magnet as shown in FIGURE 11.

The blue lateral magnet, with its internal pole piece, produces a field that is perpendicular to the static convergence field. As the blue beam passes

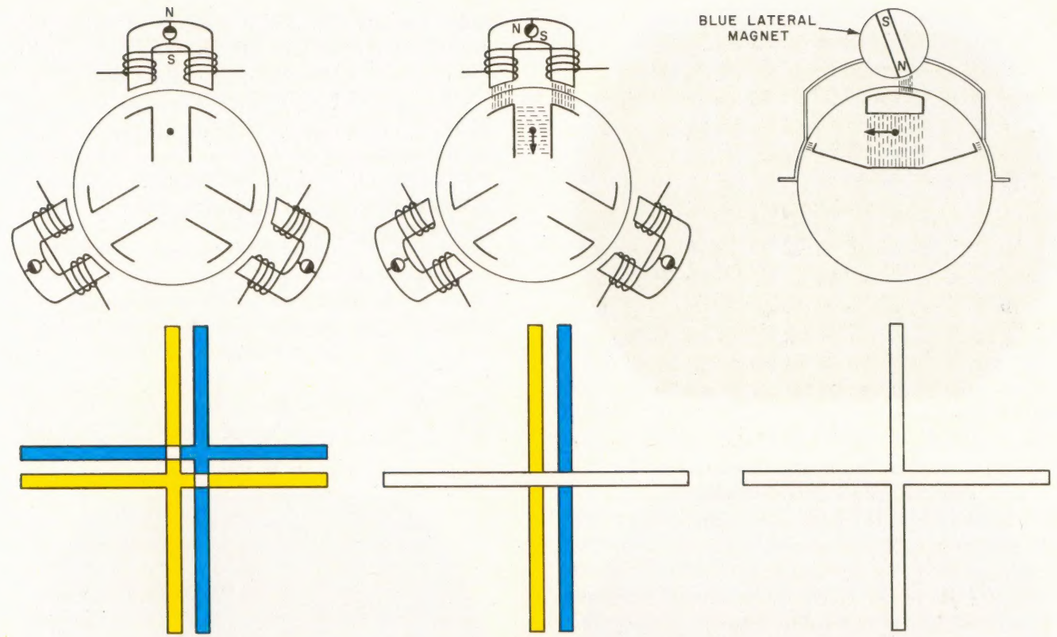


Figure 11 — Positioning the Blue Beam

through this vertical magnetic field, it is bent toward one side of the screen. The direction that the beam is moved (left or right) can be reversed by rotating this magnet through one-half revolution. The amount of lateral movement is determined (as with the three convergence magnets) by the degree of alignment of the blue lateral magnet with its pole piece. With the blue beam on the same horizontal line as the red and green (illustrated in FIGURE 12) it will be possible to move the blue beam horizontally for exact convergence of all three beams by rotating the blue lateral magnet in its holder. Providing exact convergence in the center of the screen is known as adjustment of static convergence.

Adjustment of static convergence will result in coincidence of all three beams over a small area in the center of the screen as shown in FIGURE 13. Due to the fact beam travel is slightly greater to other sections of the screen, the beams will be overconverged at all other points on the screen. In order to provide convergence over the entire screen, a dynamic convergence correction is then applied to the three beams.

Dynamic correction is obtained by use of the three electromagnets in the convergence assembly and dynamic convergence currents obtained from

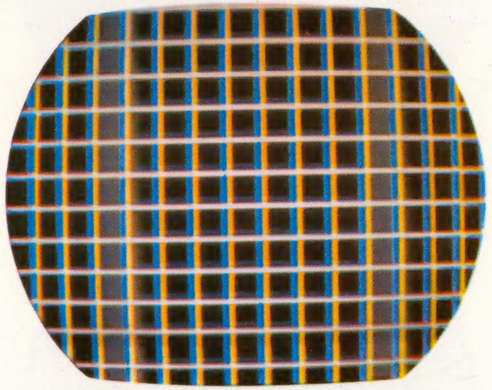


Figure 12 — Blue Lateral Magnet Misadjusted

the deflection circuits. These electromagnets are wound on the same cores used with the static convergence (permanent) magnets. The magnetic field produced by current flowing in the coils adds to or subtracts from the field produced by the permanent magnets. The dynamic field produced is always of a polarity to decrease the amount that the beams are bent toward the central axis and thus always

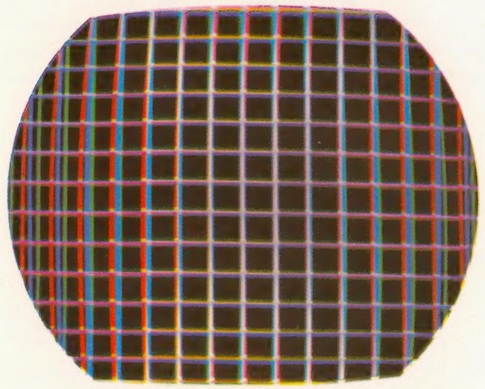


Figure 13 — Good Center Convergence

acts to reduce convergence. The total convergence force should be greatest at the edges of the screen (top, and bottom, and both sides), since beam travel is longest to these points, and should decrease as the beam approaches the center of the screen. Minimum convergence force is required in the center of the screen due to the mechanical tilt of the guns. Examples of the required horizontal and vertical dynamic waveforms are illustrated in FIGURE 14.

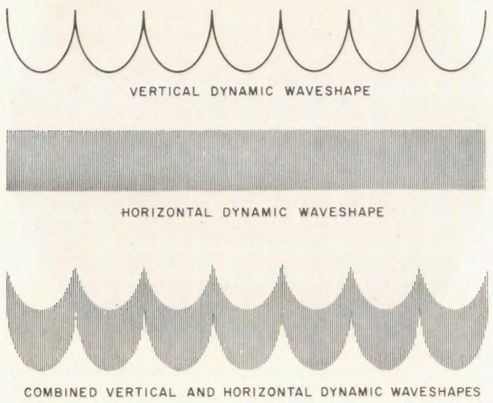


Figure 14 — Horizontal and Vertical Dynamic Waveshapes

In the 21″ color receiver dynamic convergence currents are obtained from the vertical and horizontal scanning sections, adjusted for amplitude and tilt (phase), and applied to the three dynamic convergence coils. Separate amplitude and tilt controls are located in each of the dynamic convergence circuits. Thus, it is possible to adjust blue vertical amplitude and tilt, blue horizontal amplitude and tilt, red vertical amplitude and tilt, etc.

Adjustment of a tilt control changes the timing of its corresponding convergence waveform relative to the scanning of the screen as shown in FIGURE 15. The amplitude controls determine the amount of dynamic convergence current applied to each of the electromagnets.

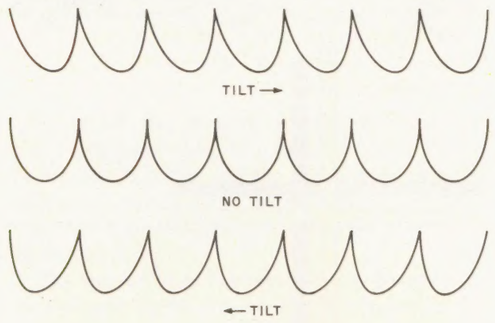


Figure 15 — Effect of the Vertical Tilt Control

Adjustment of the three sets of vertical amplitude and tilt controls are made to provide exact registration of the three beams along a vertical line through the center of the screen. Adjustment of the green and red vertical tilt controls should be made for symmetrical displacement of the red and green beams about the blue beam along the vertical center line as illustrated in FIGURE 16. The red and green vertical amplitude controls are then adjusted until the red and green vertical lines are straight and parallel to the blue vertical line in the center

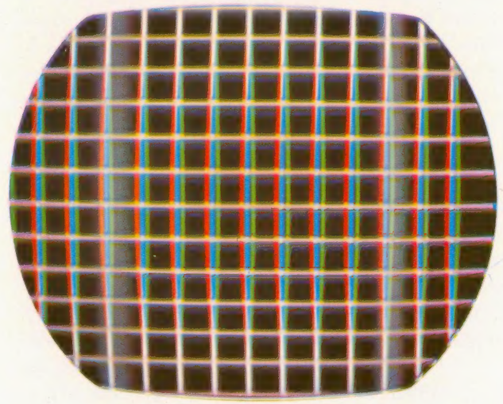


Figure 16 — Red and Green Vertical Phase Correct

of the screen. Adjustment of the red and green static convergence magnets should then be made to superimpose all three vertical lines.

With the three beams converged along the vertical center line, it is then necessary to observe the spacing of the blue horizontal lines relative to the overlapped green and red horizontal lines along this same vertical center line. Adjust the blue vertical tilt for equal displacement of the blue horizontal line at the top and bottom of the screen. Adjust the blue vertical amplitude control for equal displacement of the blue lines above or below the overlapped green and red lines along the entire vertical center line. The blue static convergence magnet can then be adjusted to merge the blue with the red and green horizontal lines, and will result in a convergence pattern similar to FIGURE 17.

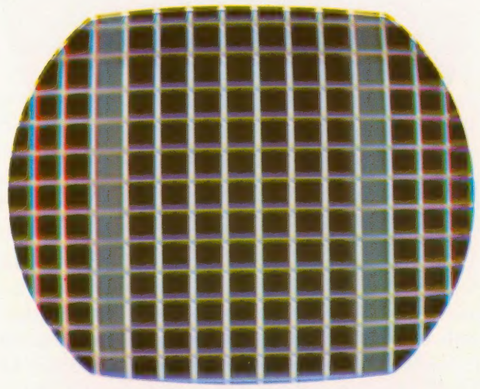


Figure 17 — Correct Static and Vertical Dynamic Convergence

Utilizing the same general procedure, horizontal dynamic convergence can be obtained by adjusting the three sets of horizontal amplitude and tilt controls. Set the blue horizontal amplitude control to maximum and adjust the blue horizontal tilt control to form a symmetrical bowed line across the center of the kinescope. This condition is illustrated in FIGURE 18.

Adjust the blue amplitude control until the horizontal blue line is approximately straight. Adjust the red and green horizontal tilt controls so that the red and green lines are symmetrical about the vertical blue lines. This condition is illustrated in FIGURE 19.

Adjust the red and green horizontal amplitude controls to make the vertical red and green lines across the horizontal axis of the raster equally

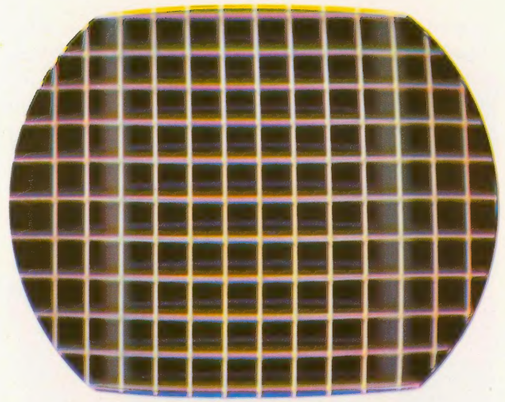


Figure 18 — Blue Horizontal Phase Correct

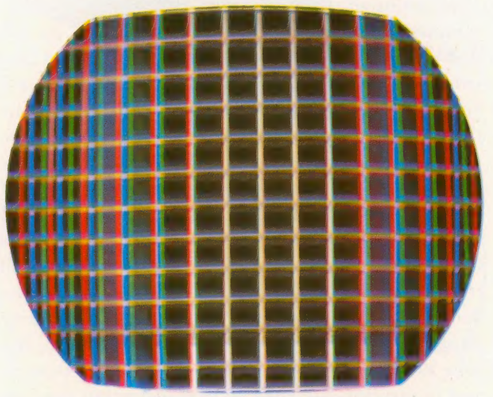


Figure 19 — Red and Green Horizontal Phase Correct — Amplitude Maximum

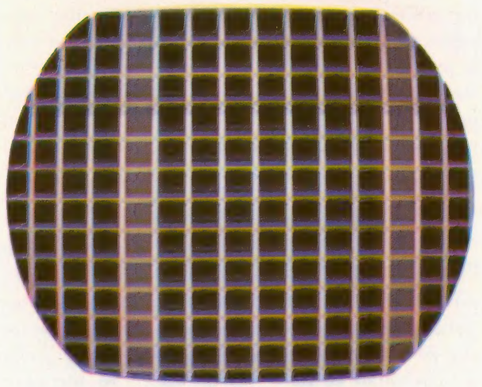


Figure 20 — Good Convergence

spaced or coincident with the vertical blue lines. Readjust the blue horizontal amplitude and phase controls to make the horizontal blue line, along the horizontal axis of the raster, parallel or coincident with the associated red and green lines. Adjust the four static convergence magnets to statically converge the three patterns in the center of the screen.

If the overall resultant convergence is not as good as the circuit is capable of producing, a step by step review of the set-up procedure will indicate what readjustments must be made to improve overall convergence. FIGURE 20 illustrates good overall convergence.

Purity

Positioning of the electron beam paths so as to obtain pure primary fields is accomplished by adjustment of the yoke position, purity magnet and color equalizer magnets. As with any shadow mask type of picture tube, it is necessary that each of the three beams approach the shadow mask at the proper angle if it is to excite only the proper dot in the trio. The color kinescope is so constructed that if a beam passes through a pre-selected "center of deflection" at the yoke and follows straight paths from this point to the phosphor screen, it will strike phosphor dots of only one color as it is deflected over the entire screen. The aim of the purity adjustment is to position the three beams in the tube neck so that they pass through these centers, and to position the yoke so that deflection appears to occur at the selected points of deflection.

Final adjustment for color purity should not be attempted until exact convergence at the center of the screen has been obtained. As with earlier color tubes, the purity magnet is adjusted and the yoke is positioned along the neck of the tube while observing a red field (contrast and color controls minimum, red screen and brightness controls maximum and green and blue screen controls minimum). The color equalizer magnets should be retracted into their housings (pulled back from the picture tube) before making these adjustments.

A microscope of 15 to 20 power is very useful in making purity adjustments. Such a magnifier permits observation of the actual area of the phosphor dots being excited. When difficulty occurs in obtaining good purity, an analysis of the type of beam displacement relative to the centers of the phosphor dots will point out the type of correction that should be made.

Precautions should be taken to keep the kinescope away from magnetic fields which might magnetize the metal shell and internal parts and thus produce localized areas of color impurity and raster distortion. FIGURE 21 illustrates the effects of extraneous magnetic fields on a kinescope which has been properly adjusted for a gray raster. Notice the extreme contamination at the center and edges of the raster.

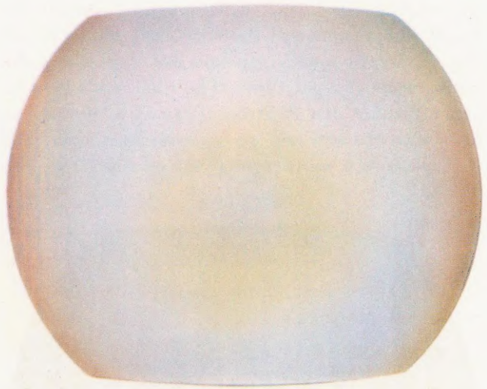


Figure 21 — Effects of Extraneous Magnetic Fields

As a precautionary measure the tube should be degaussed in its *final operating position*, in the receiver, before proceeding with purity adjustments. This degaussing may be accomplished by means of a suitable degaussing coil. This coil should be fairly large, 12 to 14 inches in diameter. An illustration of a typical degaussing coil is shown in FIGURE 22.

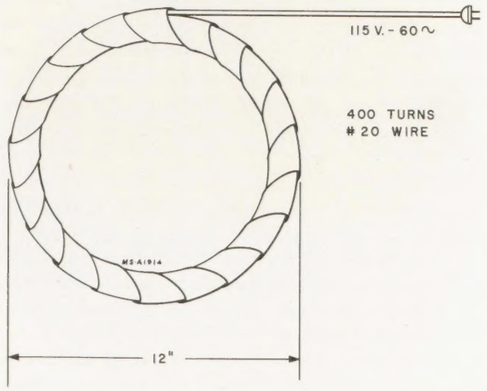


Figure 22 — Degaussing Coil

Before applying power to the degaussing coil, the color equalizer magnets should be retracted into their housings. It is not necessary to turn the color receiver off during the degaussing process. Plug the degaussing coil power cord into a 115 volt 60 cycle source. Hold the coil close to the faceplate with the plane of the coil parallel to the faceplate. After holding it in this position for several seconds, slowly back away from the set about 6 feet and turn the degaussing coil so that the plane of the coil is perpendicular to the face of the kinescope. Disconnect the line cord. After degaussing, purity adjustments may be made.

The normal sequence involves first the static convergence adjustment, next the purifying-magnet adjustment, and then adjustment in the axial position of the deflecting yoke. The yoke is moved axially toward the converging-magnet assembly as far as it will go.

The convergence in the center of the screen should be adjusted by means of the static-convergence controls and by adjustment of the blue-positioning magnet. With the red beam on and with no video signal applied, the purifying magnet should be rotated on the tube neck while its magnetic-field strength is varied until a uniform red field appears in the center of the screen as illustrated in FIGURE 23.

Figure 23 — Uniform Red Field in Center of Screen

In the central area of the viewing screen, the position of the excited area of the phosphor dot, as illustrated in FIGURE 24a, may be observed with a microscope. Rotational adjustment of the purifying magnet affects the direction in which the excited area moves, while adjustment of its field strength moves the beam in that direction. The purifying magnet should be adjusted in the above manner until the excited area is in the middle of the phosphor dot. This position of the excited area is referred to as "center landing."

Slide the deflecting yoke axially on its supports to produce the most uniform red field. The green

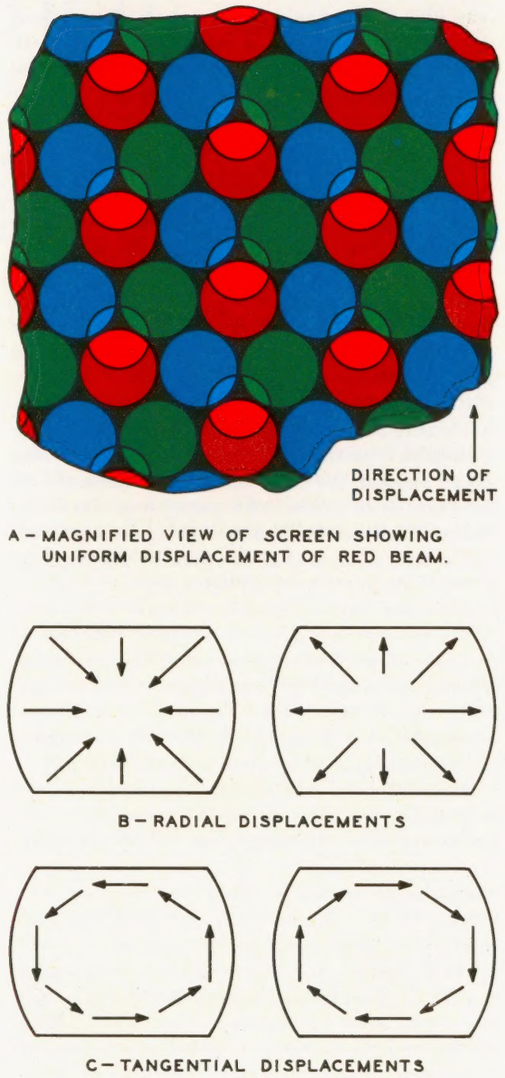


Figure 24 — Purity Displacement Diagrams

and blue fields should now be checked separately for color purity. A compromise in adjustment settings should be made if necessary to give the best red, blue and green field purity in the central region of the screen. Center convergence should be checked before and after each purity adjustment.

The relative displacements of the excited areas, with respect to the phosphor dots, may be observed with a microscope at the top center and bottom center of the raster when adjusting the yoke. If the displacements have radial components (see FIGURE 24b), the yoke should be adjusted axially until the excited areas of the phosphor dots are centered or have only a tangential displacement component as shown in FIGURE 24c.

Corrections in purity for extraneous magnetic fields may now be made using the color equalizer assembly. With the red beam on and with no video signal applied, the color equalizer magnets should be adjusted to obtain color purity over the entire screen. Purity is obtained by shifting the beam in a radial and/or tangential direction by the required amount. Next, adjust the brightness of the red, green and blue fields to obtain a white raster. The equalizer magnets are then readjusted to obtain best white uniformity over the entire screen. In addition, it may be necessary to readjust the yoke and purifying magnet slightly. Convergence of the three beams should be checked and readjusted if necessary. It should be noted that the yoke position and color equalizer adjustments have negligible effect on convergence.

The area of the screen adjacent to each of the sections of the equalizer may be observed to advantage with a microscope when the respective equalizer controls are adjusted to obtain optimum white. The electron beams should be landing entirely on their respective phosphor dots. When such is the case, the position of the excited area of the phosphor dot is referred to as "full landing." If difficulty in obtaining optimum color purity and white uniformity is still encountered, a compromise adjustment of equalizer, purifying magnet, and yoke will possibly be helpful.

SECTION II

Block Diagram Description of the 21CT662 RCA Color Television Receiver

THE 21" color television receiver can be divided into thirty (30) blocks. These blocks are illustrated in block diagram form on a pull-out in the rear section of this supplement. Included on the block diagram are the oscilloscope presentations of the bandpass waveforms of the chrominance and luminance amplifier circuits.

A switch type RF tuner in this receiver replaces the turret type used in earlier RCA color television receivers. Special circuits are incorporated for counteracting the tendency of the tuner to detune with a change in RF bias. The frequency response of the tuner is maintained between close limits for a large range of RF biases.

The tuner is linked coupled to a three stage picture IF amplifier. From FIGURE 25, it can be seen that the IF response is flat to 42.75 mc. Below 42.75 mc, the response falls off to 10 percent at the extreme end (41.75 mc) of the color bandpass. This places the color sub-carrier (42.17 mc) at the 50 percent response point. As a result, the color frequencies appear with reduced amplitude at the output of the picture IF. The correct amplitude relationship between chrominance and luminance frequencies is restored in the chrominance amplifiers.

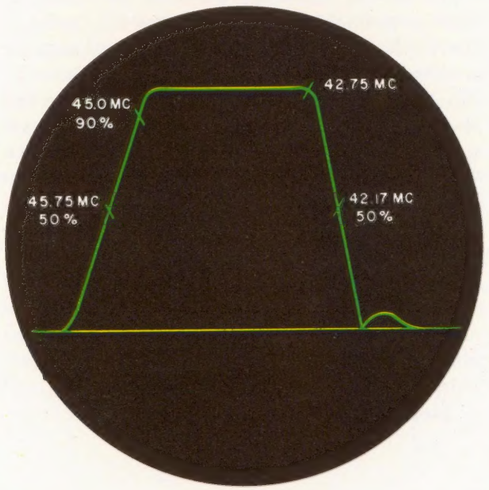


Figure 25 — Picture IF Response

The output of the picture IF is applied to the 1N60 crystal detector. The video output developed by the crystal detector is DC coupled to the first video amplifier stage.

The first video amplifier provides signal information to five (5) other circuits. The luminance signal is obtained from the cathode, and the sync, AGC, sound and chrominance signals from the plate of the first video amplifier. The luminance signal is amplified in a second video stage which is DC coupled to the cathodes of the tricolor kinescope.

The sound IF discriminator and audio amplifiers are of conventional design. The cathode circuit of the audio output stage provides the +140 volts plate supply for the picture IF, sync and sound stages.

A noise inverter stage is utilized to immunize sync and AGC from noise disturbances. Composite video, with sync negative, is applied to the cathode of this stage. The inverter is biased to cut-off at the tips of sync. Noise appearing above sync tips is amplified and is used to cancel any noise which may appear on sync before it enters the sync amplifiers. With this circuit arrangement sync stability is assured.

Chrominance information from the output of the first video amplifier is applied to the grid of the bandpass amplifier. The amplitude relationship of the color signal is restored in this stage. Gain is controlled by an ACC (automatic chroma control) voltage on the grid. The ACC voltage, which is developed in the phase discriminator, maintains proper color saturation of the viewed color picture. This action is similar to AGC action on black and white picture contrast. The chrominance signal is further

amplified by the demodulator driver which supplies drive to the demodulators. The demodulators provide color difference signals which are of sufficient peak to peak amplitude to drive the grids of the tricolor kinescope directly. In the demodulators, R-Y and G-Y signals appear across the plate load resistors. The B-Y signal is formed by matrixing portions of positive R-Y and G-Y. A negative B-Y signal is thus produced, which is then phase inverted to form the positive B-Y signal, which is DC coupled to the blue kinescope grid.

The burst keyer tube selects the burst signal from the composite chrominance signal through the action of the high voltage fly-back pulse which gates the keyer tube into conduction during burst time.

The killer circuit biases the bandpass amplifier to cut-off during monochrome transmissions. A negative horizontal fly-back pulse applied to the grid produces a large positive pulse on the plate which causes the bandpass amplifier to draw grid current during retrace time. The negative bias which is produced is sufficient to bias off the bandpass amplifier and the time constant in the grid circuit is long enough to maintain cut-off bias during trace time. When burst is present, a negative voltage from the phase discriminator biases the killer near cut-off. With the killer near cut-off only a small positive pulse is applied to the bandpass amplifier and the low grid bias which is produced permits the tube to conduct and amplify the chrominance signal. The color control is located in the plate circuit of the killer. This control varies the amplitude of the fly-back pulse applied to the bandpass amplifier grid thus determining its developed bias and controlling its gain.

The phase discriminator in the 21CT662 color television receiver functions similarly to the phase detector in the CT100. Burst and a sample of the 3.58 mc CW signal is applied to this circuit. Its output is a DC control voltage which, when applied to the grid of the reactance tube, shifts the frequency of the 3.58 mc CW oscillator in accordance with the polarity and magnitude of the DC control voltage. When burst and the 3.58 mc CW oscillator are in phase, zero control voltage results. The hue control, located in the 3.58 mc CW input circuit to the phase discriminator, varies the phase of the 3.58 mc CW supplied to the phase discriminator. Varying the phase of this 3.58 mc input causes the 3.58 mc oscillator to change frequency until the oscillator is again in step with the reference signal.

The vertical oscillator and output stages are of conventional design. A special winding on the vertical output transformer supplies a sawtooth of 60 cycle current to the convergence circuits. Two taps on this winding supply sawtooth shaping currents to the vertical convergence circuit.

The horizontal deflection circuit consists of the following stages: horizontal oscillator and control, horizontal output, high voltage rectifier, damper, high voltage regulator and focus rectifier. The horizontal deflection circuits provide 25KV of regulated high voltage.

The convergence circuit is of the tubeless type. Sine waves for dynamic horizontal convergence are obtained from a ringing circuit. A flyback pulse from the horizontal output transformer rings a tuned circuit providing the necessary waveform. The vertical parabola is obtained by integrating a sawtooth of current supplied by the vertical output stage.

A horizontal blanking amplifier is incorporated in the 21CT662. This amplifier is required since the color demodulators receive the entire composite signal. The burst signal would produce a yellow stripe during horizontal retrace. To overcome this color presentation during retrace, the blanking amplifier supplies a large negative pulse to the screen grid of the 2nd video amplifier causing the kinescope to cut-off during horizontal retrace time.

The tricolor kinescope performs an additional function in the 21CT662. Since there is no external matrix, the luminance and chrominance signals are matrixed within the kinescope. The luminance (Y) signal, sync positive, is applied to the cathode and positive chrominance (R-Y, G-Y, B-Y) signals are applied to the grids. Matrix takes place between the grid and cathode of the kinescope. Background controls are located in grid circuits of the green and blue guns. Screen controls function as in the CT100 color television receivers.

The low voltage power supply is composed of two selenium rectifiers providing +285, +380 and −20 volts. All filament circuits are fused except the tri-color kinescope, shunt regulator and damper, which have separate sources of filament supply and are biased with +B voltages.

Circuit Description of the 21CT662 RCA Color Television Receiver

RF Tuner—KRK35

This tuner is a modified version of the RCA incremental inductance type tuners used in black and white receivers and is now ideally suited to color television receiver requirements. Particular care was taken to achieve the wide-band performance and uniform flat response on all channels essential for good performance in color television. FIGURE 26 shows four possible response curves for the RF amplifier is composed of two triodes, "Miller Effect" can be very pronounced.

To overcome the effects of changes in RF bias, an additional wafer is utilized in this tuner. From FIGURE 27 it can be seen that coils L18 through L26 are connected, in series, between the grid and plate of V1. This inductance forms a parallel resonate circuit with the grid to plate capacity. This greatly increases the plate to grid impedance minimizing

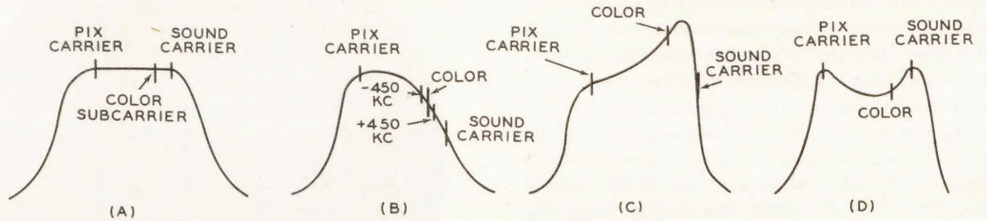


Figure 26 — Conditions of RF Bandpass Response

bandpass. The desired condition is shown in FIGURE 26a. The others shown would probably be acceptable for black and white reception, but for color reception the sub-carrier and its sidebands are altered to such an extent as to cause color distortions. Under certain conditions, the responses shown in FIGURES 26b and 26c can occur in black and white receivers even though the tuner is aligned in the manner prescribed by the service notes. It is known that the input capacity of an amplifier changes as the bias varies with signal strength (AGC). This condition is known as "Miller Effect" and can distort the desired response of the amplifier. Due to the fact that the grid to plate capacity is greater in triodes than in pentodes and since the cascode RF

the detuning effects in the grid circuit. The inductances are switched from channel to channel maintaining the proper response regardless of the signal strength.

A continuous type UHF tuner is mounted at the rear of the VHF tuner in models equipped for UHF reception. By positioning the channel selector switch to the UHF position, the VHF fine tuning control automatically becomes the UHF tuning control. The UHF tuner can be continuously tuned from channels 14 through 83. The VHF converter tube is cascaded with the 40 mc output of the UHF tuner and provides amplification before the converted UHF signals are link coupled to the 40 mc IF amplifiers on the main receiver chassis. No con-

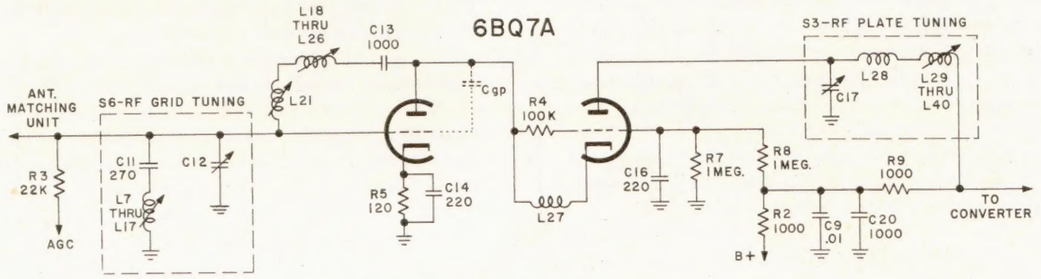


Figure 27 — RF Amplifier Schematic Diagram

version gain is realized in the UHF tuner making this additional amplification necessary.

Pix IF — Second Detector

The picture IF circuitry is very similar to that used in our present black and white receivers. Three dual purpose, triode-pentode, tubes are used (2-6AZ8, 1-6AN8) utilizing the pentode sections as the IF amplifiers. The triode sections are used as sync amplifiers and vertical oscillator.

The IF strip is of printed circuit construction with the component parts physically mounted on top of this separate sub-assembly. The interstage transformers are the bi-filar type wound on separate forms. Adjacent channel picture and sound traps are shunted across the input link from the RF Unit. An accompanying channel sound trap, tuned to 41.25 mc, is mutually coupled to the first picture input transformer. This trap provides the necessary sound rejection at the IF frequency level.

AGC voltage is applied to the first and second IF stages. The plate voltage (+140) of the third IF is supplied from the cathode of the audio output stage. Failure of the audio output tube results in loss of picture as well as loss of sound.

The picture detector consists of a 1N60 crystal. Its output is DC coupled to the first video amplifier as shown in the simplified schematic in FIGURE 28.

Extra care must be maintained when aligning the IF strip. The chrominance sub-carrier must be located at the 50% response point on the overall response curve as shown in FIGURE 29. The frequency of the sub-carrier is located at 42.17 mc, this carrier being 3.58 mc from the picture carrier (45.75 mc). It is also important that the upper sideband of the sub-carrier be at the 10% response point. If this response point, 41.67 mc (42.17 — 0.5) is lower than 10%, insufficient gain and poor color fidelity will result. The upper sideband 42.67 mc (42.17 + 0.5) is located at the 90-100% response point. The proper placement of these frequencies allows for an adequate range of fine-tuning adjustment before there is apparent loss of color.

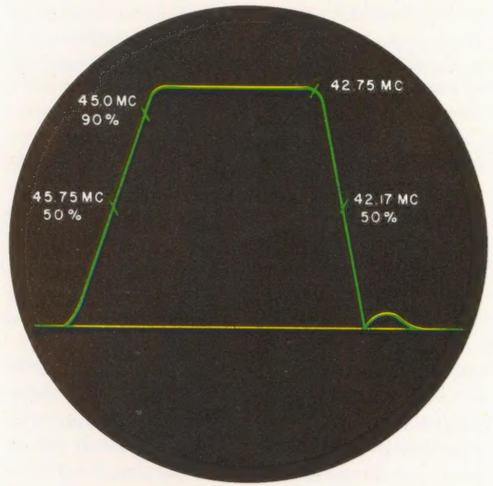


Figure 29 — Overall Picture IF Response

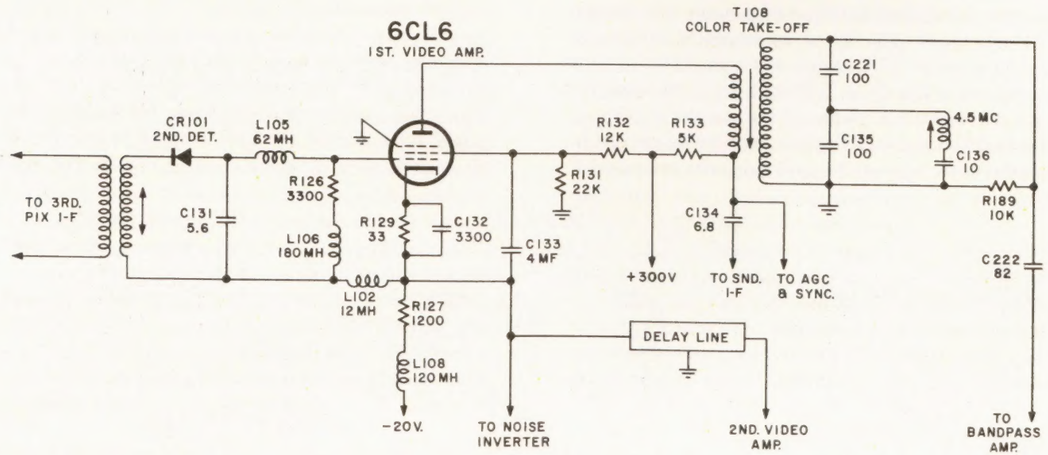


Figure 28 — Picture Detector and 1st Video Amplifier

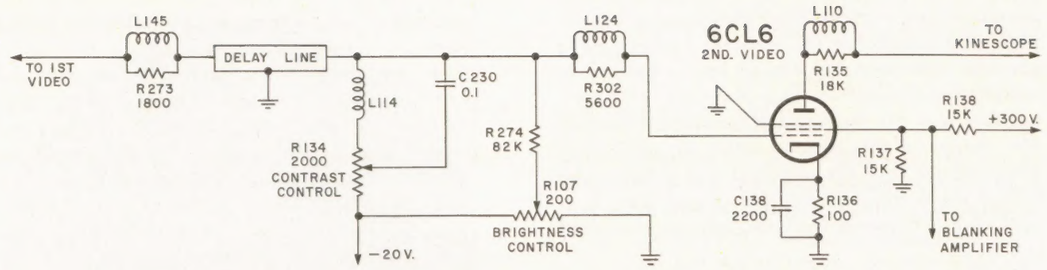


Figure 30 — 2nd Video Amplifier Circuitry

Video Amplifier

The output of the second detector is DC coupled to the grid of the first video amplifier. The luminance (Y) signal is developed across a resistor in the cathode circuit. The polarity of sync is negative at this point and is below ground potential by a negative 20 volts. This is necessary to properly bias the 2nd video amplifier. A delay line is located between the first and second video amplifiers providing the proper delay and DC coupling of the two stages.

The contrast and brightness controls are located in the grid circuit of the 2nd video amplifier as illustrated in FIGURE 30. The grid bias is controlled by the brightness potentiometer which in turn affects the plate voltage. Since the 2nd video amplifier is DC coupled to the cathode of the kinescope, the DC bias on the kinescope affected when changing the bias of the second video amplifier, thus affecting the degree of kinescope brightness. As the grid of the 2nd video amplifier is made more negative, the plate voltage of the 2nd video amplifier and the cathode of the kinescope become more positive, resulting in reduced brightness.

The required kinescope drives are obtained by means of a voltage divider in the plate circuit of the 2nd video amplifier. These peak to peak voltages are: 125, 110 and 95 to the red, green and blue guns respectively. These unequal drive voltages are necessary to compensate for the unequal phosphor efficiencies of the tricolor kinescope.

A positive vertical blanking pulse is applied to the cathodes of the kinescope which provides for the necessary vertical retrace blanking. Horizontal blanking is accomplished by the horizontal blanking amplifier which provides a large negative pulse to the screen grid of the 2nd video amplifier. This produces a positive pulse on the plate which in turn drives the kinescope into cut-off during horizontal retrace time.

In the above discussion, we traced the luminance signal from the cathode of the 1st video amplifier to the cathode of the kinescope. It is of interest to note that in addition to this, the plate circuit of the 1st video amplifier provides sound, sync, AGC and chrominance information.

Sound IF — Audio

The sound IF, ratio detector and audio amplifiers are of printed circuit construction mounted on a separate sub-assembly. The sound IF amplifier utilizes a 6U8 triode-pentode with the triode section serving as a noise inverter stage. The sound IF carrier (4.5 mc) is capacity coupled from the plate of the 1st video amplifier to the grid circuit of the 1st sound IF amplifier. A 6T8, triple diode-triode is used as a ratio detector, 1st audio amplifier and AGC clamp for RF bias. The cathode circuit of the audio output stage provides +140 volts plate supply for the 3rd picture IF, 1st sound IF and the 1st and 2nd sync amplifiers.

Sync — AGC — Noise Inversion

Composite video, developed across R133 in the plate circuit of the 1st video amplifier, is fed to the grid circuit of the 1st sync amplifier. The R/C network in the grid circuit has a long time constant and charges to the horizontal blanking pedestals. The sync amplifier is normally cut-off due to the charge on C186 and C187. However, it goes into conduction when positive sync pulses appear on the grid. Therefore, only sync pulses appear in the plate circuit, the video information being separated in the grid circuit. The plate supply voltage is obtained from the cathode circuit of the audio amplifier.

The second sync amplifier grid circuit is biased slightly positive causing the tube to draw a slight

amount of grid current. Since the AC coupled sync pulses are negative at the grid, the positive going portions will cause the second sync amplifier to conduct into saturation. This limits any video signal that may get through the first sync amplifier. The output of this stage, positive in polarity, is differentiated by C189 and R211 and is fed to the grid of the horizontal oscillator control tube. Vertical sync is obtained from the split load of R210 and R212.

To improve sync stability, a noise inverter stage is utilized. Composite video, obtained at the luminance load in the 1st video amplifier, is applied to the *cathode* of the noise inverter tube. During noise-free signal conditions, the inverter tube is cut-off. The video signal applied to the cathode is of *negative* polarity, and since the tube is normally biased to cut-off, any noise appearing beyond the tips of sync drives the tube into conduction. These noise pulses are amplified and become negative in the plate circuit. The noise pulses are then coupled to the grid of the 1st sync amplifier and over-cancel the noise on sync, leaving holes in the sync pulses as shown in FIGURE 31. A noise threshold control located in the grid circuit of the noise inverter is adjusted so that cut-off coincides with the tips of sync. Bias on the noise inverter consists of a constant voltage potential obtained from the horizontal oscillator grid circuit, plus a variable voltage potential from the AGC amplifier. The combination of these two voltages provides a bias for proper operation of this stage at all signals levels.

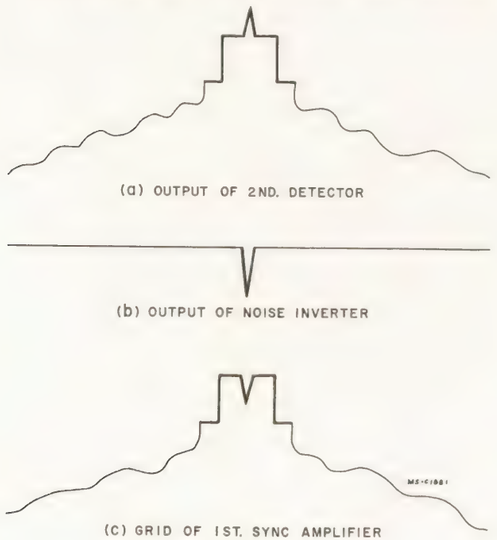


Figure 31 — Noise Cancellation

The AGC amplifier is of the pulsed type and therefore requires a variable DC bias voltage controlled by the amplitude of horizontal sync. Composite video (sync positive) is obtained from the plate circuit of the 1st video amplifier. This AC signal is converted to DC by means of an R/C network (C173, R182) and control grid rectification. As the amplitude of horizontal sync varies, the DC bias voltage varies. The AGC control, located in the grid circuit, varies the fixed bias level on the tube. The combination of the fixed bias and the bias which varies with sync controls the conduction of the AGC amplifier. Positive horizontal fly-back pulses applied to the plate causes the tube to conduct at the end of each horizontal line. When the amplitude of horizontal sync increases, the AGC amplifier conducts harder thus developing a larger negative voltage in the plate circuit. This negative bias voltage is applied to the grids of the RF and IF amplifiers controlling their gain.

Bandpass Amplifier — Demodulator Driver

The chrominance signals are developed across T108, a chrominance take-off transformer, in the plate circuit of the 1st video amplifier. This transformer is tuned to peak at 4.1 mc and compensates for the upper-sideband chrominance losses in the picture IF amplifiers and rejects low frequency luminance information. A parallel trap shunting the secondary of the take-off transformer and housed within T108, is tuned to 4.5 mc providing sharp cut-off above the chrominance band of frequencies. The overall response at the plate of the bandpass amplifier stage is shown in FIGURE 32. The important check points are 4.1 mc at 65%, 3.58 mc at 100% and 3.0 mc at 65%.

Amplification in this stage is controlled by a variable bias voltage obtained from the color killer and phase discriminator circuits. This bias is proportional to the amplitude of the burst signal applied to the phase discriminator. A weak burst signal develops a small bias allowing the bandpass amplifier to operate at maximum gain. A high amplitude burst signal results in a large bias and thus reduces the chrominance amplification in the bandpass amplifier. Since the burst and chrominance signals are of near equal frequency, transmission variations will affect the magnitude of the two signals proportion-

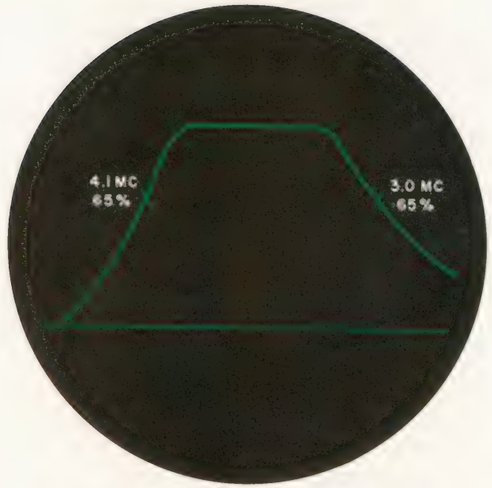


Figure 32 — Overall Response — Bandpass Amplifier Plate

ately. Therefore, the phase discriminator provides a bias to the grid of the bandpass amplifier which maintains the proper chrominance output level.

The output transformer in the plate circuit of the bandpass amplifier is tuned to pass the 3-4 mc chrominance band. This transformer couples the chrominance information to the grid of the demodulator driver, a 6AG7. This high gain pentode provides sufficient drive for high level demodulation. When sweeping the entire receiver from the antenna terminals to the plate of the demodulator

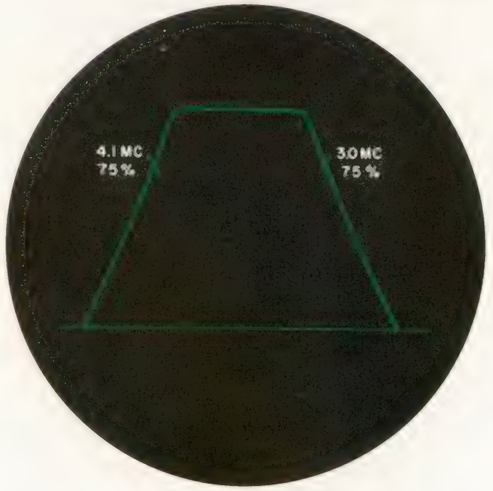


Figure 33 — Overall Response — Demodulator Driver Plate

driver, the overall waveshape should be as shown in FIGURE 33.

Color Killer — ACC

The purpose of the color killer is to disable the chrominance portion of the receiver during black and white transmissions. Operation of the killer is controlled by a bias voltage obtained from the phase discriminator. When the receiver is tuned to black and white transmissions, little bias is developed in the phase discriminator and the color killer operates at high gain, thereby disabling the chrominance amplifiers. For ease of explanation, a simplified schematic of the killer and associated circuitry is shown in FIGURE 34.

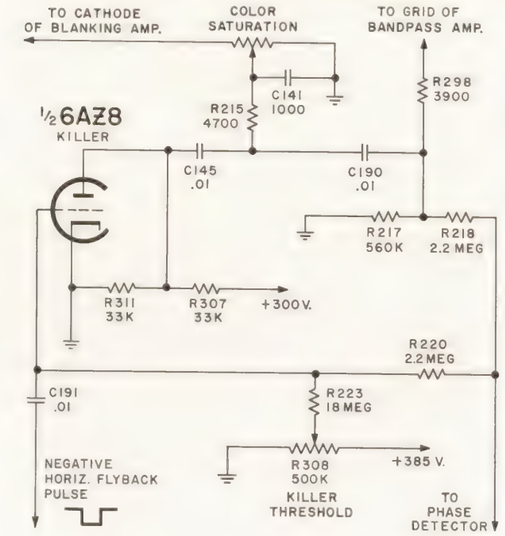


Figure 34 — Color Killer and ACC Circuitry

A retrace pulse applied to the killer is amplified and AC coupled to the grid of the bandpass amplifier as a positive pulse during retrace time. With the killer operating at maximum gain, as during a black and white program, this pulse develops sufficient grid leak bias to cut off the bandpass amplifier. The time constant in the bandpass amplifier grid is long enough to hold it below cut-off during the horizontal line interval.

During a color telecast the burst signal coincides with conduction of the bandpass amplifier. Burst is then amplified and keyed to the phase discriminator circuit. These burst pulses are rectified in the phase discriminator producing large negative and

positive voltages. The negative voltage so produced is filtered and applied to the grids of the killer and bandpass amplifier stages. Thus a voltage proportional to the amplitude of burst at the phase discriminator is utilized as a bias for these stages during color reception. With the presence of burst, the negative bias supplied by the phase discriminator limits the conduction of the killer. As a result, only a small positive pulse is applied to the grid of the bandpass amplifier. Under this condition, no grid current flows and the gain of the amplifier is controlled by the negative voltage developed by the phase discriminator. Since the amplitude of this negative voltage is proportional to the amplitude of burst, the gain of the bandpass amplifier will be in inverse proportion to the amplitude of burst. The bandpass amplifier control voltage is called the "Automatic Color Control" (ACC). The action of this circuit is similar to that of the AVC circuit of an ordinary superheterodyne radio receiver. As the signal increases, the bias increases, decreasing the gain of the amplifier.

The chrominance signal level is adjusted by an attenuator located in the plate circuit of the killer tube called the "Color" control. As this control is rotated in a counter-clockwise direction, a larger positive pulse is applied to the grid of the bandpass amplifier. Burst is then amplified by a greater amount, developing a larger ACC bias and reducing the gain of the amplifier during the horizontal line interval. Chrominance gain is increased by advancing the color control in a clockwise direction. This reduces the amplification of burst, resulting in a smaller ACC bias voltage and greater amplification of the chrominance signals.

Color AFC

Burst is gated from the output of the bandpass amplifier to the input of the phase discriminator by means of the burst keyer tube. The composite chrominance signal containing burst is coupled to the cathode of the keyer, however, the keyer tube is normally cut-off due to the long time constant in its grid circuit. At the end of each horizontal line a retrace pulse is applied to the grid of the keyer. This positive pulse drives the tube into conduction allowing the coincident burst pulse to be amplified. The phase discriminator transformer is located in the plate circuit of the keyer and the burst signal is developed across this transformer.

The keyer tube draws grid current when driven into conduction charging C192 to approximately the peak-to-peak value of the keyer pulse obtained from the horizontal output transformer. During line intervals C192 discharges through R224 applying a large negative voltage between the grid and cathode, thus maintaining the keyer tube at cut-off in the absence of a keyer pulse.

Operation of the phase discriminator and reactance tube is similar to the RCA model CT100 color television receiver. The output of the 3.58 mc CW oscillator is coupled to the phase discriminator through a 10 K resistor. The HUE control varies the phase of the 3.58 mc CW reference signal at the input of the phase discriminator. If the incoming burst is not in phase with the reference signal, the phase discriminator develops a correction voltage. This correction voltage is applied to the grid of the reactance tube which in turn changes the phase of the oscillator. The 3.58 mc CW transformer, T115, located in the plate circuit of the 3.58 mc oscillator, supplies the proper CW reference signals to the grids of the R-Y and G-Y demodulators.

Color Demodulator

The 21CT662 employs high level type of demodulation. A simplified circuit arrangement is illustrated in FIGURE 35. This system allows the tri-color kinescope to be driven directly from the output of the demodulators without the use of the intermediate amplifiers. As can be seen from FIGURE 35, the 3.58 mc CW reference signal and the 3.58 mc chrominance information drives the two triode demodulator tubes, one producing R-Y and the other G-Y. Both output signals are positive in polarity and are of proper amplitude to directly drive the grids of the color kinescope. The B-Y signal is developed from the combined R-Y and G-Y signals. The formula for B-Y in terms of R-Y and G-Y is: B-Y equals —2.73(R-Y) —5.36(G-Y). B-Y is developed by selecting portions of the R-Y and G-Y signals in the ratio just given. Since positive polarity signals rather than the negative polarity signals are used to matrix B-Y, a B-Y phase inverter is utilized. The output of this B-Y phase inverter supplies a required positive polarity B-Y signal of proper amplitude to drive the blue gun of the kinescope.

Low-pass plate circuit filters made up from L129 and C239 in the R-Y demodulator, L143 and C247 in the B-Y demodulator, and L130 and C241 in the G-Y demodulator reject all 3.58 mc signal information and all higher harmonics generated in the demodulators. (For theory of demodulator operation, see a later section titled, "Demodulation Theory.")

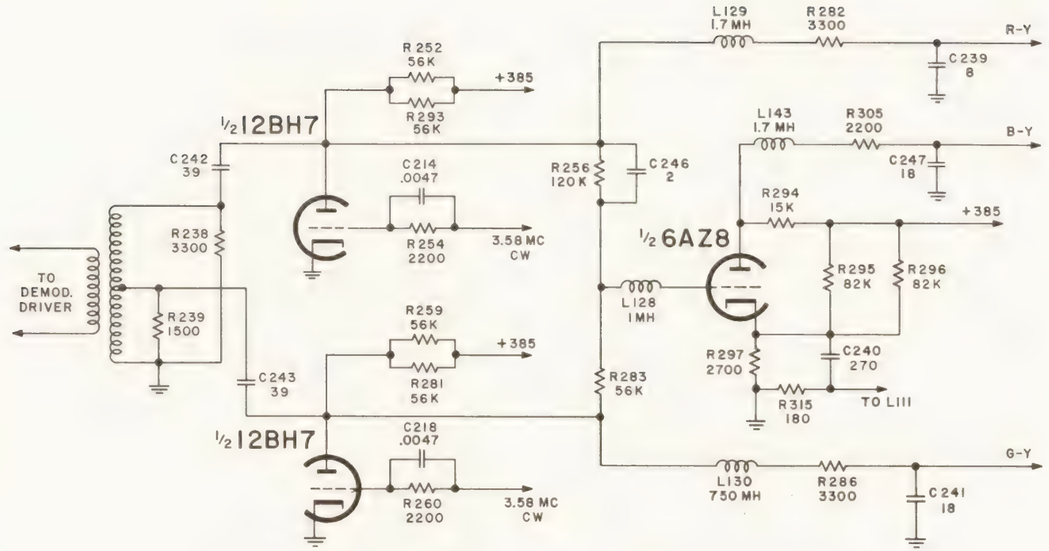


Figure 35 — Demodulation Circuit

Vertical Deflection

The vertical deflection angle of the 21" kinescope is 55 degrees. This is an increase of 20 degrees over the 35 degree angle of the 15GP22. Since greater deflection power is required, a 6AQ5 (pentode) is utilized as a vertical output tube. From the schematic in FIGURE 36, it can be seen that a blocking oscillator provides the required vertical drive which is coupled through C167 to the grid of the vertical output tube. The discharge circuit is composed of C165 and R173, located in the plate circuit of the vertical oscillator.

Use of a pentode in the vertical output stage requires the incorporation of a correction network to preserve linearity. Feedback from the plate of the output tube through R172 and C167 to the junction of C165 and R173 provides a correction voltage to the output stage. This feedback and by-pass capacitor C166 stabilize the vertical sweep at the top and bottom of the picture. Undesired high frequencies produced in the plate circuit are by-passed around the vertical output transformer by C228, improving the output waveform.

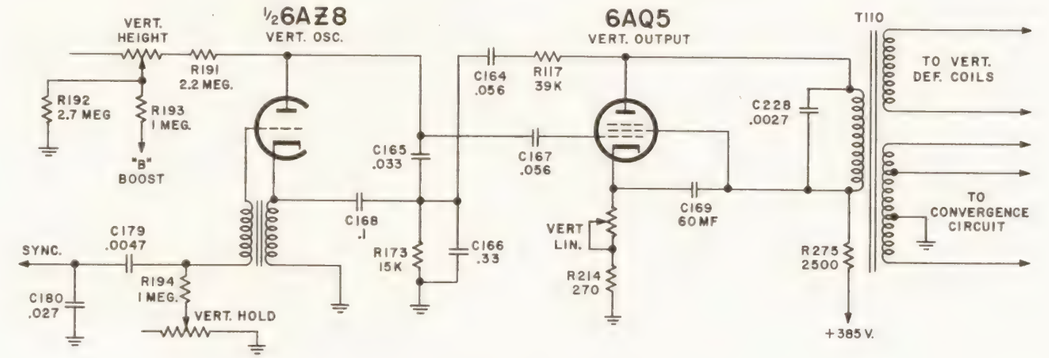


Figure 36 — Vertical Deflection Circuitry

A separate secondary winding on the vertical output transformer provides vertical scanning currents for the dynamic convergence circuits.

Horizontal Deflection and High Voltage

The horizontal deflection circuit of the 21CT662 is unique in the fact that a conventional fly-back circuit is used to supply a required 20 watts of regulated high voltage power. Also, this circuit supplies adequate deflection current to scan the 21AXP22 which has a deflection angle of 70 degrees.

A simplified schematic of the horizontal deflection and regulated power supply is shown in FIGURE 37. It can be seen that the plate of the shunt regulator is tied directly to the high voltage supply. The grid is fed from the junction of R149 and the "HV Adj." control, which consists of the B Boost bleeder. The cathode is connected to +380 volts. Assuming that the grid voltage of the regulator is adjusted so that it is drawing sufficient current to maintain a 25KV high voltage output, the regulator action is as follows: If the tri-color tube requires more current, this will place a greater load on the output stage causing a slight drop in B Boost voltage and, likewise, the grid of the regulator. In turn, this reduces the current through the regulator. Equilibrium is reached when the drop in the high voltage is just sufficient to reduce the regulator current by the amount of increase in the kinescope current. In this way, the load on the high voltage system is maintained constant and the high voltage is regulated. The value of high voltage is also controlled manually by R151, which sets the bias on the shunt regulator.

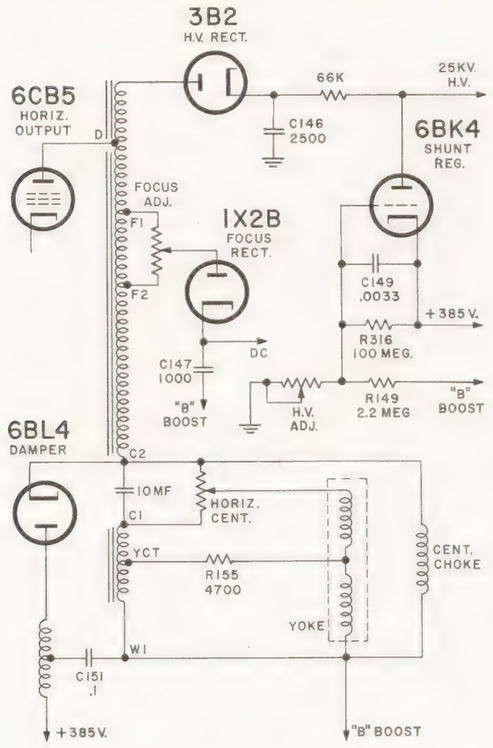


Figure 37 — Horizontal Deflection and High Voltage

The DC focus voltage required by the 21" kinescope is obtained from a 1X2B focus rectifier. The plate of the rectifier is fed from a variable tap on the "Focus Adj." control. This control is located between the points F1 and F2 on the horizontal output transformer. The focus control is adjusted for best overall focus of the tri-color kinescope.

The horizontal deflection coils are shunted across a portion of the horizontal output transformer. Horizontal centering is accomplished by means of the horizontal centering control located between the points C2 and C1 on the output transformer. Plate current of the horizontal output tube flows through this control providing centering voltage. Since the yoke is connected to the variable tap of this control, horizontal raster centering can thus be attained.

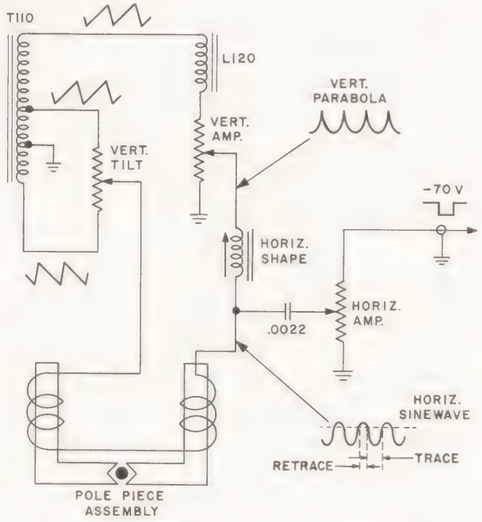


Figure 38 — Simplified Convergence Circuit

Convergence Circuitry

Horizontal Convergence

A convergence system using sine waves for horizontal convergence is shown in a simplified schematic in FIGURE 38. The current through each of the convergence coils (one of three is shown in FIGURE 38) is individually adjustable in amplitude and phase. The phase is adjusted by the "Horizontal Shape" control used to resonate along with its associated capacitor (.0022uufd) at the line frequency. The sine wave is produced by ringing this resonate circuit with a pulse obtained from the horizontal fly-back transformer. The amplitude of the sine wave is controlled by the "Horizontal Amplitude" control. This control varies the amplitude of the ringing pulse which in turn affects the sine wave amplitude.

Vertical Convergence

A vertical frequency sawtooth voltage obtained from a secondary winding on the vertical output transformer is fed to L120, shown in FIGURE 38. The current flowing through L120, which is parabolic in waveshape, produces a vertical frequency voltage parabola across the "Vertical Amplitude" control. This control regulates the amount of vertical parabola voltage applied to the convergence coils.

Two vertical sawtooth voltages obtained from the secondary winding of the vertical output transformer are applied across the vertical tilt control. Since these voltages are of similar shape but of opposite polarity, zero voltage with respect to ground is obtained near the center of this control. By mixing these sawtooth voltages with the vertical parabola, the waveshape of the parabolic voltage applied to the convergence coils can be varied as shown in FIGURE 15.

Horizontal Blanking Amplifier

Since the burst information is allowed to pass through the demodulator driver stage, a horizontal blanking pulse is applied to the screen grids of the 2nd video amplifier. This is necessary with the utilization of the new ACC and Killer circuits in this receiver. The burst signal is demodulated during horizontal retrace time and is passed on to the grids of the kinescope. If horizontal blanking was not provided, a yellow vertical stripe would appear in the picture on the left side of the tri-color tube. A fly-back pulse, obtained from the horizontal output transformer, is fed to the grid of the Blanking Amplifier shown in FIGURE 39. This positive pulse is amplified and appears as a large negative pulse in the output of the amplifier stage. The output of this stage is AC coupled to the screen grid of the 2nd Video Amplifier and the resulting positive blanking pulse at the *plate* of the amplifier drives the tri-color tube into cut-off during horizontal retrace time.

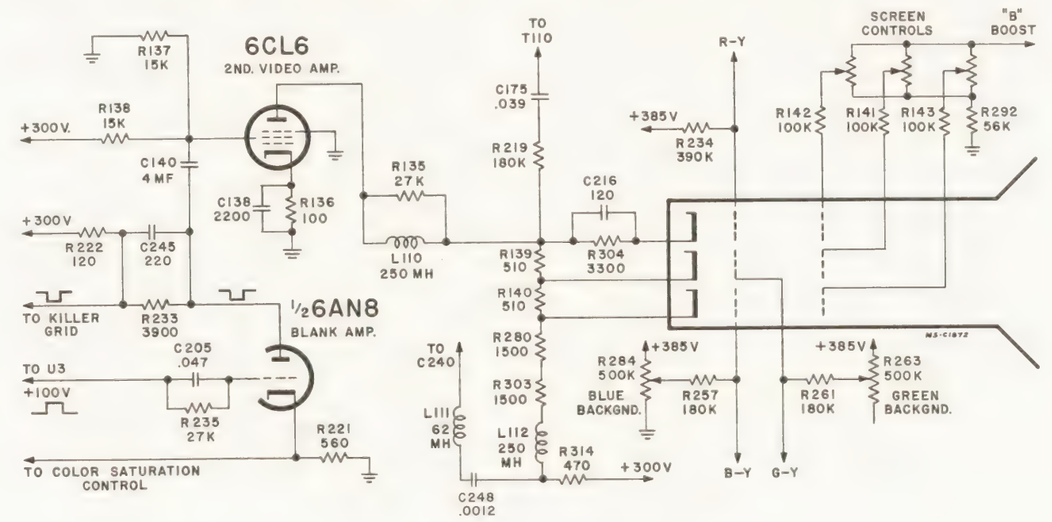


Figure 39 — Kinescope and Blanking Amplifier Circuit

Kinescope Circuitry

As previously explained, specific ratios of light radiations of the red, blue and green phosphors are required to produce the desired white kinescope screen. If a satisfactory gray scale is to be obtained, these ratios must be maintained for all light levels. For any particular tri-gun color kinescope, the ratio of gun currents must be kept constant. This will vary among kinescopes due to variations in the efficiency of the phosphors. In adjusting the kinescope, a white raster is obtained by properly setting the screen-grid voltage of each gun. This adjustment is made to coincide with a mid-position brightness control setting. Video gain controls are unnecessary in this receiver since the video signals are direct coupled from the second detector to the cathode of the kinescope. Thus, the picture highlights are established by the screen controls. After obtaining the proper white raster, the contrast control is set at the proper point for a good black and white picture. The brightness control is then reduced to obtain a darker (just visible) picture and the blue and green background controls are adjusted so that the change in their DC voltages is proportional to their video drives in order to maintain a picture with a uniform gray scale. The screen controls are then rechecked for proper picture highlights.

To allow as much freedom as possible of adjustment of the screen controls without being troubled by the vertical retrace lines, a negative vertical pulse from the vertical deflection output stage is fed to the cathodes of the kinescope by C175 and R219, thus cutting off the kinescope during vertical retrace.

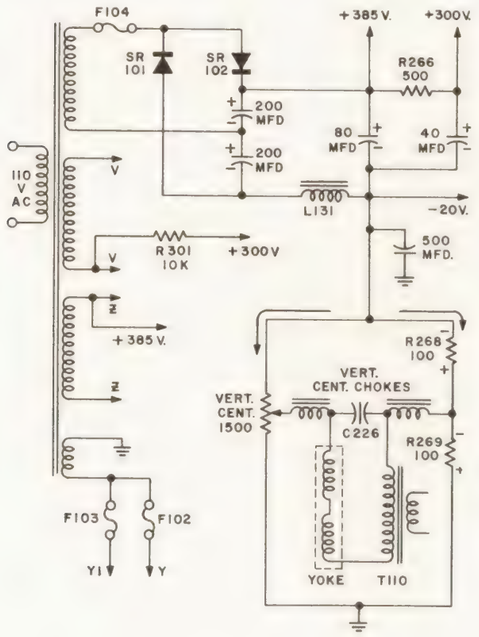


Figure 40 — Low Voltage Power Supply Circuit

Low Voltage Power Supply

The power requirements of the 21CT662 are fulfilled by means of a voltage doubler circuit arrangement as shown in FIGURE 40. Each rectifier has a sixty-cycle ripple component in the power supply. Two +B voltages are supplied (+380 and +285) to meet the receiver voltage requirements. A negative 20 volts created in the ground return of the doubler provides a bias supply to the video and horizontal output stages.

All filaments, except the kinescope, shunt regulator and damper, are fused by either F102 or F103. These high voltage tubes are not fused since they are supplied from separate filament windings. This is necessary because the cathodes of the kinescope and damper are maintained at a large positive potential and to prevent arcing to the filament, these filament windings on the power transformer must be left ungrounded.

Vertical Centering

The action of the vertical centering control can best be described by referring to the schematic in FIGURE 40. Current flows through the centering control and R268 and R269. When the centering control is set at mid-range, there is an equal potential on both ends of the vertical deflection coils. Under this condition, no DC current flows through the yoke. If the control arm is moved to the right, current flows up through the yoke and the reverse takes place when the arm is moved to the left. The centering chokes maintain the yoke and output transformer (T110) above AC ground potential.

SECTION III

Basic Theory of High Level Demodulation

SINCE THE 21CT662 demodulates color difference signals the use of high level demodulation is most desirable. With this technique the output of the demodulator is of sufficient amplitude to drive the grids of the tri-color kinescope directly without the use of intermediate amplifiers. Also by direct coupling the chrominance signals to the kinescope grids, the need for DC restoration is eliminated.

There are three methods by which high level demodulation may be accomplished. Two methods employ the use of three triode type tubes while the other method employs two triodes. The 21CT662 uses three tubes, however, for ease of understanding, all methods will be discussed.

One of the circuits which involves the use of three tubes is illustrated in FIGURE 41. The transmitted chrominance information is impressed across a transformer which is in series with the plate load resistor of each of the demodulators. The reference 3.58 mc CW signal is applied to the grids of these tubes. Tubes one (1), two (2) and three (3) demodulate B-Y, R-Y and G-Y signals respectively. Therefore the reference signal must be of the proper phase as indicated in FIGURE 41. The resistance and capacitance in the grid circuits are adjusted so that the time constant is long enough to permit the tube to operate class C and at the same time the resistance must be low enough to permit adequate plate current during positive swings on the grid. During positive swings of grid drive, the plate current should be sufficient to lower the plate voltage to about 25 volts. Also this condition should be such that it is relatively independent of a change in plate voltage. Therefore when a chrominance signal is applied to the plate, this signal is clamped at 25 volts when the tube conducts. When the tube is cutoff the plate voltage tends to rise and the value it attains depends upon the time constant of the tube output capacitance. At the same instant the tube cuts off, the plate voltage starts to rise and the chrominance signal on the plate adds to this voltage. FIGURE 42c illustrates this clamping action. If the chrominance signal on the plate is in phase with the grid drive, positive peaks of chrominance will occur at the same instant that the tube conducts. Thus the positive chrominance peaks are clamped at 25 volts. When the tube cuts off the chrominance signal is going negative while the plate voltage starts positive. However, the chrominance signal is greater in amplitude. Thus the plate voltage swings negative. Since the voltage developed across the plate load resistor is filtered to 3.58 mc, the average level of plate voltage change appears in the output. The plate is at a high impedance level to 3.58 mc, therefore the chrominance signals and the grid signal appear at this point.

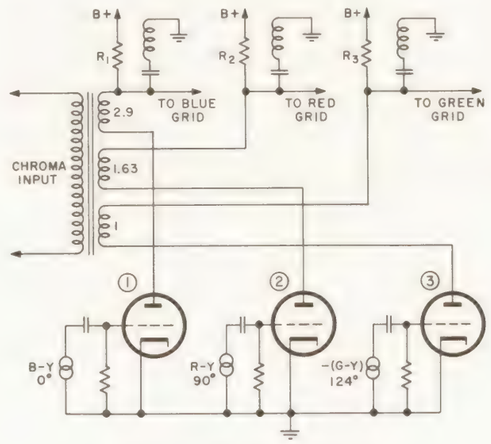


Figure 41 — High Level Demodulation

When chrominance signal is 180 degrees out of phase with the grid signal, the negative peaks of the chrominance signal are clamped at 25 volts. This occurs since the plate signal is negative when the positive signal on the grid causes the tube to go into conduction. When the tube cuts off, the plate voltage begins to rise and at the same time, the chrominance signal swings positive. The two voltages add producing a large positive swing on the plate. This is illustrated in FIGURE 42. When the chrominance signal is in quadrature with the

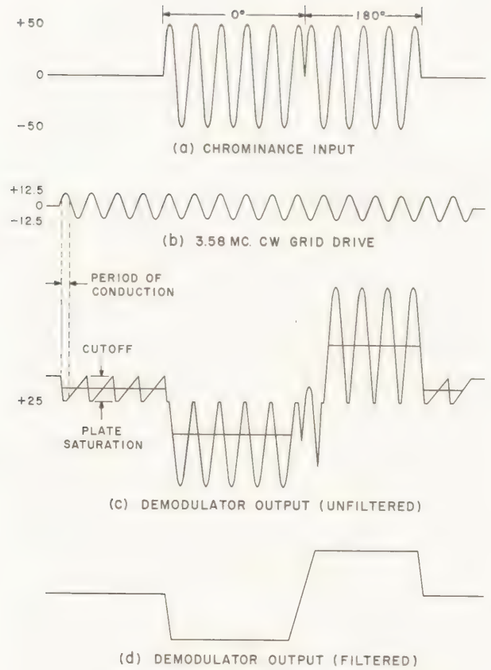


Figure 42 — In Phase Signals

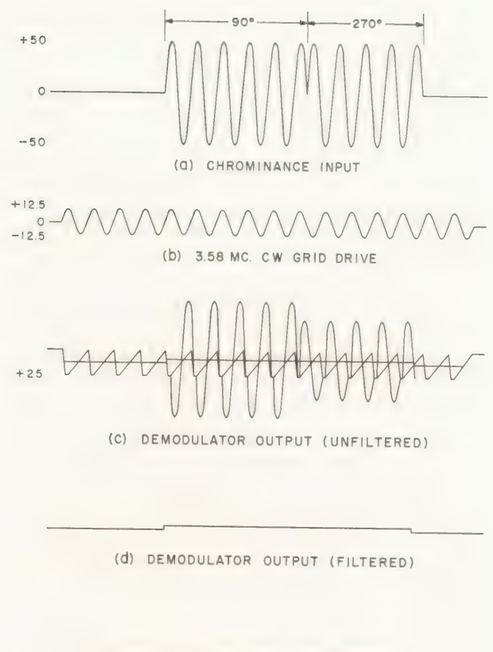


Figure 43 — Quadrature Phase Signals

grid drive, the tube conducts while the signal on the plate is going through zero. Thus the zero points of the chrominance signal are clamped at 25 volts. Since the chrominance varies equally above and below this point, the average video output is zero as seen in FIGURE 43.

Chrominance signals which are between in phase and quadrature phase with the grid signal, produce a video output whose amplitude is proportional to the phase difference. Chrominance signals which are nearly in phase with the grid signal, produce more output than signals which are nearly in quadrature with the grid signal. Since the output of the demodulators drive the kinescope directly, utilizing no external matrix, there is one point for consideration; the chrominance signals are reduced in amplitude before transmission in order to prevent chrominance overshoots and this reduction in amplitude must be recovered in the receiver.

This recovery can be accomplished in the turns ratio of the chrominance coupling transformer shown in FIGURE 41. Before transmission, the R-Y signal is reduced to .877. The B-Y signal is reduced to .493 and the G-Y signal is increased to 1.423. Therefore, the transformer turns ratio of the red, green and blue drives to each demodulator plate should be the reciprocal of the reductions or in the ratio of 1/.877 : 1/1.423 : 1/.493 respectively. With green as a reference, the ratio becomes:

R-Y : B-Y : G-Y = 1.63 : 2.9 : 1

"Bootstrap" High Level Demodulation

ANOTHER CIRCUIT which employs the use of only two triode demodulators is illustrated in FIGURE 44. It should be recalled that the G-Y signal may be obtained from the addition of —0.51 R-Y and —0.19 B-Y. Thus it is only necessary to demodulate R-Y and B-Y signals. A novel "bootstrap" technique is utilized where the G-Y signal is obtained from a common cathode resistor in the R-Y and B-Y demodulators. The plate loads and the cathode resistor are adjusted for the required R-Y, B-Y and G-Y signal amplitudes.

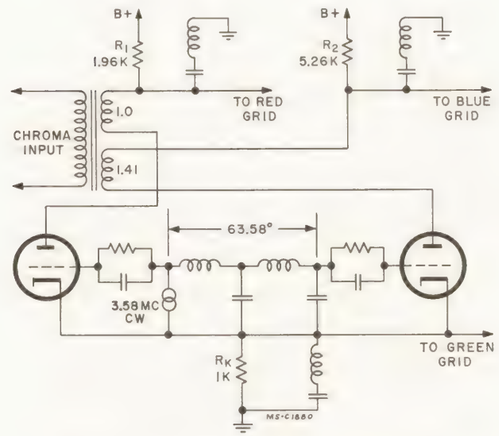


Figure 44 — "Bootstrap" High Level Demodulation

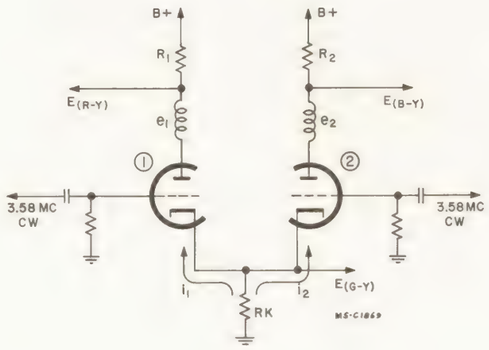


Figure 45 — Simplified "Bootstrap" Circuit

A simplified circuit of this system of demodulation is shown in FIGURE 45.

i_1 = current in R-Y demodulator
i_2 = current in B-Y demodulator
e_1 = voltage applied to R-Y plate (chrominance)
e_2 = voltage applied to B-Y plate (chrominance)
R_1 = plate load R-Y
R_2 = plate load B-Y
R_k = common cathode resistance (G-Y load)
$E_{R\text{-}Y} = i_1 R_1$
$E_{B\text{-}Y} = i_2 R_2$
$E_{G\text{-}Y} = (i_1 + i_2) R_k$

When R-Y = 0

G-Y = $i_2 R_k$

Since G-Y = —0.51 R-Y —0.19 B-Y and R-Y = 0:

$i_2 R_k$ = —0.19 B-Y

Thus: $\frac{i_2 R_2}{i_2 R_k} = \frac{\text{B-Y}}{0.19\ \text{B-Y}}$

$\frac{R_2}{R_k} = \frac{1}{0.19}$

If R_k = 1K, then R_2 = 5.26K.

When B-Y = 0

G-Y = $i_1 R_k$

Since G-Y = —0.51 R-Y —0.19 B-Y and B-Y = 0

$i_1 R_k$ = —0.51 R-Y

Thus: $\frac{i_1 R_1}{i_1 R_k} = \frac{\text{R-Y}}{0.51\ \text{R-Y}}$

$\frac{R_1}{R_k} = \frac{1}{0.51}$

If R_k = 1K, then R_1 = 1.96K.

Therefore the ratios of plate load resistors equals:

R-Y : B-Y : G-Y = 1.96K : 5.26K : 1K

With the circuit arrangement shown in FIGURE 45, both R-Y and B-Y current flows in the common cathode resistor. When there is a chrominance signal applied to the plate of tube number 1, which is in quadrature with R-Y signals, there should be no R-Y output. A signal that is in quadrature with R-Y will cause maximum B-Y output. This causes B-Y current to flow through tube number 2 and the common cathode resistor. Any voltage across this resistor is present at the R-Y output. Therefore signals in quadrature with R-Y signals are

present in the R-Y output.

This condition is highly undesirable and steps are taken to minimize resulting cross-talk. By changing the phase of the 3.58 mc CW signal applied to the grid of tube number 1 so that it is not in phase with R-Y but leans slightly toward B-Y phase, an equal and opposite B-Y current will flow through tube number 1 which will cancel the B-Y signal present at the R-Y output due to the common cathode resistor. This phase is critically adjusted so that *only* R-Y information is present in the output. Since this same condition is present in the B-Y section, its applied CW phase is also critically adjusted for R-Y signal cancellation.

In order to calculate the phase requirements, we must assume that the demodulators are perfect switches:
Then:

$$e_1 = (G\text{-}Y) - (R\text{-}Y)$$
$$e_2 = (G\text{-}Y) - (B\text{-}Y)$$

The phase angle requirements of demodulators 1 and 2 can be calculated by finding e_1 and e_2 in terms of R-Y and B-Y. It is known from previous calculations that G-Y equals —0.51 R-Y —0.19 B-Y. Substituting these values in the e_1 and e_2 formulas we find that:

$$e_1 = (-0.51\ R\text{-}Y - 0.19\ B\text{-}Y) - (R\text{-}Y)$$
$$-1.51\ R\text{-}Y - 0.19\ B\text{-}Y$$

$$e_2 = (-0.51\ R\text{-}Y - 0.19\ B\text{-}Y) - (B\text{-}Y)$$
$$-0.51\ R\text{-}Y - 1.19\ B\text{-}Y$$

As discussed in the previous demodulator circuit which employs the use of three tubes, the amplitudes of R-Y and B-Y must be increased by the reciprocal of .877 and .493 respectively.
Therefore:

$$e_1 = \frac{-1.51\ R\text{-}Y}{.877} - \frac{0.19\ B\text{-}Y}{.493}$$
$$-1.72\ R\text{-}Y - .386\ B\text{-}Y$$

From FIGURE 46:

$$\tan \Theta_1 = \frac{.386}{1.72} = .244$$
$$\Theta_1 = 12.6°$$

Also:

$$e_2 = \frac{-0.51\ R\text{-}Y}{.877} - \frac{1.19\ B\text{-}Y}{.493}$$
$$-.582\ R\text{-}Y - 2.42\ B\text{-}Y$$

From FIGURE 47:

$$\tan \Theta_2 = \frac{.582}{2.42} = .24$$
$$\Theta_2 = 13.5°$$

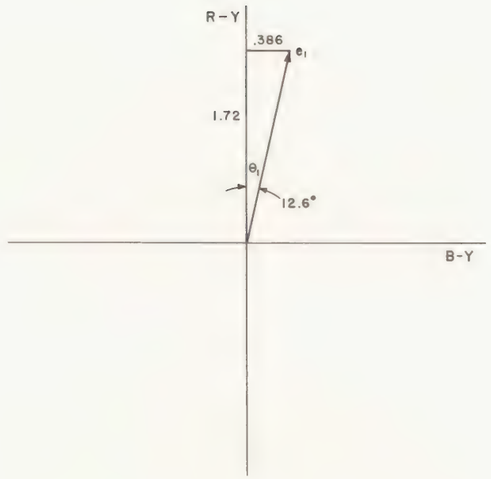


Figure 46 — Vector Representation of Demodulator 1

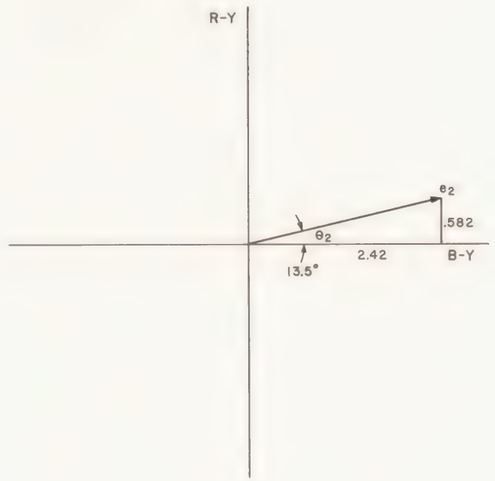


Figure 47 — Vector Representation of Demodulator 2

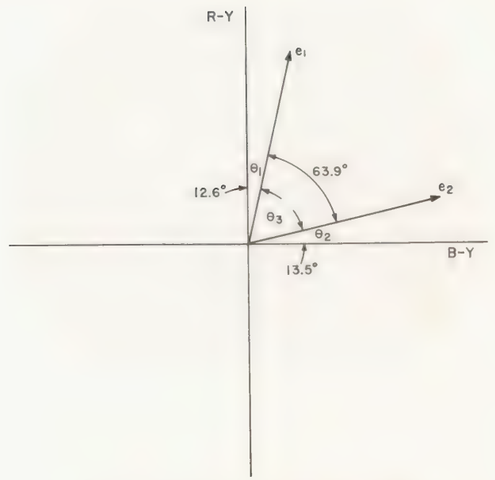


Figure 48 — Vector Representation of the "Bootstrap" High Level Demodulation

The angle Θ_3 can be determined by adding Θ_1 and Θ_2 and subtracting this sum from 90° as shown in FIGURE 48.
Thus:

$$\Theta_3 = 90° - (\Theta_1 + \Theta_2)$$
$$90° - (12.6° + 13.5°)$$
$$90° - 26.1°$$
$$63.9°$$

The amplitude of e_1 and e_2 shown in FIGURES 46 and 47 can be calculated as follows:

$$e_1 = \frac{1.72}{\cos \Theta_1} \qquad e_2 = \frac{2.42}{\cos \Theta_2}$$
$$\frac{1.72}{\cos 12.6°} \qquad \frac{2.42}{\cos 13.5°}$$
$$1.76 \qquad 2.49$$

The ratio of e_1 to e_2 is:

$$e_1 : e_2 = 1.76 : 2.49$$
$$e_1 : e_2 = 1 : 1.41$$

This unequal drive requirement of the two demodulators can be adjusted for in the turns ratio of the chrominance coupling transformer as shown in FIGURE 44.

Demodulation in the 21CT662 RCA Color Television Receiver

THE 21CT662 utilizes a somewhat modified circuit whereas it employs the use of three triodes. Two of the triodes are used to demodulate R-Y and G-Y color difference signals and the other triode is used as a combined matrix and phase inverter for obtaining the B-Y signal. All of these color difference signals are of the high level type and drive the kinescope directly. R-Y and G-Y signals are demodulated rather than some combination with B-Y since a B-Y demodulator requires a greater chrominance drive than either R-Y or G-Y. This is due to the fact that B-Y is reduced to .493 before transmission, whereas R-Y and G-Y are reduced to .877 and 1.432 respectively. The chrominance drive to the demodulators must be the reciprocal of these values. A B-Y signal can easily be obtained by matrixing —2.73R-Y —5.36G-Y. However, since positive R-Y and G-Y signals are demodulated, they must be matrixed, then phase inverted to form a positive B-Y signal. A simplified drawing of the demodulator circuit used in the 21CT662 is illustrated in FIGURE 35. The chrominance drive is applied to the demodulators by means of a center tapped chrominance coupling transformer. The G-Y demodulator requires the least drive therefore it is driven from the center tap of the transformer. Resistive loads are placed across the secondary of this transformer in order to provide the required bandwidth. Positive R-Y and G-Y signals are developed across their respective demodulator plate load resistors. Three low pass filters, L129 and C239 in the R-Y output, L130 and C241 in the G-Y output and L143 and C247 in the B-Y output, reject all 3.58 mc carrier and sideband information and pass the lower frequency color difference signals on the grids of the tri-color kinescope. To provide the B-Y signal, the outputs of the R-Y and G-Y demodulators are fed into a resistive matrix composed of R256 and R283. The output of this matrix is phase inverted and amplified by the B-Y phase inverter tube. Since the outputs of the demodulators are direct coupled through the matrix to the grid of the phase inverter, a positive DC bias voltage is placed on this grid. To bias the tube properly a larger positive voltage is applied to the cathode by means of a voltage divider network which con-

sists of R296 and R297.

Operation of the demodulators and B-Y matrix can be checked with the aid of a color bar generator. The color receiver and the color bar generator should first be adjusted for a normal color bar pattern on the face of the kinescope. To check R-Y phase, connect a 100K resistor from each of the blue and green grids to ground. The red bar pattern observed should be similar to the one illustrated in FIGURE 49. The sixth (B-Y) bar, counting from the left, should have the same brightness as the background. The burst discriminator transformer (T112) may be adjusted to meet this condition with the HUE control set at the center of its range. To check B-Y phase, remove the 100K resistor from the blue grid and connect from the red grid to ground. The blue bar pattern observed should be similar to the one illustrated in FIGURE 50. The third (R-Y) bar should have the same brightness as the background. The top core of the 3.58 mc CW transformer (T115) may be adjusted to meet this condition. G-Y phase may be checked by removing the resistor from the green grid and connecting it from the blue grid to ground. The green bar pattern observed should be similar to the pattern illustrated in FIGURE 51. The first and seventh bars should have the same brightness as the background. Remove the resistors and the bar pattern presented should be similar to the normal bar pattern illustrated in FIGURE 52.

Figure 50 — Blue Matrix — Red and Green Missing

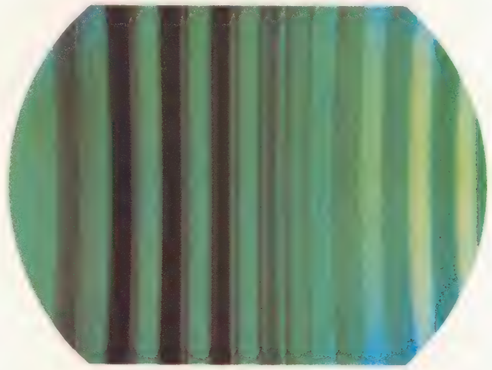


Figure 51 — Green Matrix — Red and Blue Missing

Figure 49 — Red Matrix — Green and Blue Missing

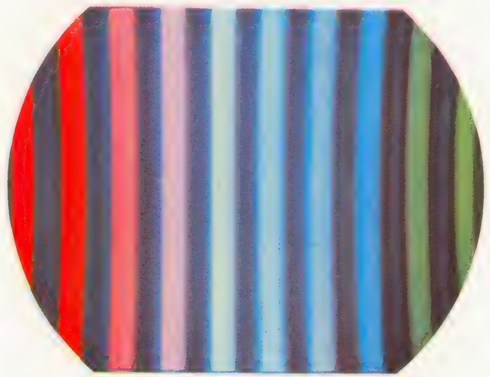


Figure 52 — Normal Bar Pattern

SECTION IV

Servicing Hints

Pix and Sound OK — No Color

Check the following, using the color bar generator:
1. Fine tuning and chroma controls
2. Tubes in the color circuits
3. The 3.58 mc crystal
4. DC bias on the bandpass amplifier
   a. If high, check the burst keyer and phase discriminator circuits.
   b. If the burst input to the keyer is low, check alignment of the RF, IF and bandpass amplifiers.
5. Bias on the grid of the 3.58 mc oscillator
   a. If zero, oscillator is inoperative
6. Waveforms at the plate of the demodulators
   a. If normal, trace signals to the kinescope grids to isolate the trouble.

Sound OK — Picture Bloomed

Check the following, receiver tuned to a black and white or color broadcast:
1. Demodulators and phase inverter tubes for open filaments
2. Kinescope bias voltages
3. High voltage regulation

Sound OK — Poor Purity

Check the following:
1. Check the adjustment of the purity magnet, equalizer magnets and yoke
2. Degauss the kinescope and recheck purity adjustments

Sound OK — Picture Misconverged

Check the following, using a dot-bar generator:
1. Static (center) convergence by adjusting magnets in the convergence assembly
2. Dynamic convergence controls for proper settings
3. Waveforms at the input of the dynamic convergence circuit
4. Continuity of electro-magnets in the convergence assembly.

Pix and Sound OK — No Color Sync

Check the following, using the color bar generator:
1. Phase discriminator
2. Reactance tube
3. 3.58 mc oscillator
4. Bias at the grid of the reactance tube
   a. If high, ground the grid of the reactance tube. If color then rolls slowly through the picture, the trouble lies in the phase discriminator circuit. If color remains badly out of sync, the trouble lies in the reactance tube or oscillator circuits.

Pix and Sound OK — Improper Color

Check the following, using the color bar generator:
1. Hue control for proper operation and range
2. Demodulator and phase inverter tubes
3. With an oscilloscope, check the waveforms at the plates of the demodulators and at the grids of the kinescope.

Set-Up Procedure of the 21CT662 RCA Color Television Receiver

1. Remove the fuse in the B+ supply to the horizontal output section.
2. Place a milli-ammeter, set for 500Ma, across the fuse clip.
3. While observing the meter, adjust the core of the horizontal tuning coil for minimum current. This should occur at 200 to 250Ma.
4. Using a high voltage probe which extends the voltmeter range to at least 30KV, measure the high voltage with a normal brightness raster.
5. Adjust the high voltage control for 25KV and observe that it does not vary over the useable range of brightness. If necessary advance horizontal drive to maintain 25KV regulation as brightness is advanced. Do not advance horizontal drive to the point where a drive line appears.
6. Tune in a station.
7. Adjust the height, width and linearity controls for approximately ¾″ overscan at top, bottom and both sides.
8. Turn the red screen control maximum clockwise and the blue and green screen controls counterclockwise.
9. Turn the contrast and color controls to minimum.
10. Adjust the purity magnet for best red field. (Reposition yoke if necessary.)
11. Set the brightness control at mid-position.
12. Adjust the kinescope screen controls for grey raster.
13. Tune in a good black and white picture.
14. Connect Dot-Bar generator to the receiver.
15. Tune Dot-Bar generator for stable vertical and horizontal bars. (Adjust brightness, contrast and Dot-Bar generator output for a clear bar pattern without station interference, but also insure that the receiver is being synchronized by station sync. In order to obtain correct horizontal dynamic convergence phase, it is necessary to perform dynamic convergence adjustments while the receiver is being scanned at the station rate.)
16. Adjust the convergence magnets and the blue lateral magnet for good center screen convergence.
17. Turn contrast to minimum and readjust controls to obtain a red raster.
18. Readjust the purity magnet and yoke if necessary for best overall purity. (Color equalizer magnets should be retracted into their housings.)
19. Check the green and blue fields independently. If necessary, a compromise should be made for best red, green and blue purity.
20. Adjust the screen controls for a grey raster. (Brightness control at mid-position.)
21. Adjust red, green and blue vertical dynamics and the four convergence magnets for best registration of the vertical center line.
22. Adjust red, green and blue horizontal dynamics and the four convergence magnets for best registration of the horizontal center line.
23. Make final purity checks on red, green and blue fields.
24. Turn contrast and chroma to minimum, brightness fully clockwise and backgrounds to mid-position. Adjust screen controls for a high-level 8200° K raster.
25. If necessary, adjust the color equalizer magnets to correct any lack of uniformity of the grey raster around the edges of the screen.
26. Increase contrast to obtain a high contrast picture. (Avoid blooming due to excessive contrast.)
27. If the low brightness portions of the picture shift from grey to some hue, rebalance the screen control settings to restore color balance in these areas.
28. Restore original hue of the low lights (low brightness portions of the picture) by adjustment of the background controls.
29. Adjust the screen controls for color balance (white) in the high light (high brightness) areas of the picture.
30. Re-adjust the background controls for color balance in the low lights.
31. Repeat steps 29 and 30 until proper color tracking (no change from black, grey and white) is obtained as the contrast and brightness controls are varied over their useful ranges.
32. Disconnect the antenna and connect the color bar generator to the receiver. Tune for proper bar presentation.
33. Clip a 100 K resistor from each of the blue and green guns to ground.
34. The bar pattern observed should be similar to the pattern shown in FIGURE 49. The sixth bar should have the same brightness as the background. The HUE control may be adjusted in order to meet this condition.
35. Remove the resistor from the blue grid and place between the red grid and ground. The bar presentation should be similar to that in FIGURE 50. The third bar should have the same brightness as the background. T115, top core, may be adjusted to meet this condition.
36. Remove the resistor from the green grid and connect between the blue grid and ground. The first and seventh bars should have the same brightness as the background as illustrated in FIGURE 51.
37. Remove the resistors and bar generator and reconnect the antenna to the receiver.
38. Make final receiver check on a black and white program and a color program if available.

ANT. MATCHING UNIT

** FOR COMB. UHF-VHF ANT. CONNECT TRANS. LINE TO VHF TERM. FOR SEPARATE UHF AND VHF ANTENNAS; DISCONNECT W52 AND CONNECT TRANSM. LINES TO RESPECTIVE TERMINALS.

R-F TUNER

TUNER UNIT KRK-37

VHF SECTION KRK-35

L5 FM TRAP, L4 I-F TRAP, C2 5, L3 I-F TRAP, J1-F, P51-M, W51, ANT. T.B. VHF UHF, W53, **W52, S51 VHF UHF, W54

C4 33, C3 27, L2, L1, C1 18, T1 ANTENNA MATCH. TR.

S1-F REAR, S1-F FRONT, L11 L10 L9 L8 L7, L12 L13 L14 L15 L16 L17, C11 270, R18 1000

R54 470 K, R51 6800, R52 56K, R53 3900

C10 1000, R3 10 K, R-F A.G.C.

S1-E REAR, S1-E FRONT, C13 1000, C12 1-4, L21 L20 L19 L18, L22 L23 L24 L25 L26, L27

V1 6BQ7A R-F AMPL.

R4 100 K, R5 120, C14 220, L68, C6 470

S1-D REAR, S1-D FRONT, R6 100, C15 1000

P402, J2, T3, R7 1 MEG., C16 220, R8 1 MEG.

R2 1000, +285 V., C9 .01, C8 470

S1-C REAR, S1-C FRONT, L28, C17 0.8-3, L34 L33 L32 L31 L30 L29, L35 L36 L37 L38 L39 L40, C18 1000, C19 270

R9 1000, C20 1000

C21 1000, C7 1000, C22 1000, R11 10 K

TP-1, R10 100 K, R14 10, R13 100 K, L42, L49, L50 L51 L52 L53 L54, R15 3300, S1-B REAR

TP-2, L55, C28 0.8-3, C34 0.68 MMF, L48 L47 L46 L45 L44 L43, C27 1000, S1-B FRONT

R17 12 K, C26 1-4, C32 10, C29 0.8-3, V2 6X8 OSC. & MIXER

T2 CONVERTER TRANS., TP 3, C24 56, L41, A B C D, R12 39 K, C25 82

C23 55-80, S1-A REAR, C33 FINE TUNING, S1-A FRONT, L56, L67 L66 L65 L64 L63 L62 L61, L57 L58 L59 L60

C31 0.68 MMF, R16 100 K, C30 10, L6, R1 120

FRONT AND REAR SECTIONS OF S1 VIEWED FROM FRONT AND SHOWN IN CHANNEL NO. 2 POSITION.

UHF SECTION

C406, C403 A, C403 B, L403 A, L403 B, L411 (OPTIONAL), C407 1-4, C413, L409, CR 401 K3D OR 1N82 MIXER

V401 6AF4 OR 6AF4A OSC.

C405, C404, C402, C401, L402, L401, ANT T.B., L404

R402 6800, R404 4700, L407, L406, L405, C408 10-50, L410, L408, C409 1000, C411 1000, R405 3300, C410 1000, W401

PC 101-A

T101 SOUND I-F TRANS., R101 47K, C101 56, C103 .01, R102 120

V101A 6U8 SOUND I-F AMPL., +15 V., +120 V.

T102 RATIO DET. TRANS., C104 2200, C105 100, R103 1800, C107 1200

V102A 6T8 RATIO DET., C106 5 MF., R106 27K, R104 150, R105 39K, C108 .0022, C109 .0033, W103, W102, C110 .01

V102B 6T8 AUDIO AMPL., GG -0.6V., +92V., R109 10 MEG., C114 .0027, +121 V.

V103 6AQ5 AUDIO OUTPUT, KK, BLU, +355 V., C115 .0027, CC, RED, +140 V., +355 V.

SOUND I-F DET. - AUDIO

T103 AUDIO OUTPUT TR., SP-101, SP-102

R112 1.5 MEG., R113 820K, R111 330K

AA, BB, EE, C134 6.8, R107 B 1 MEG. VOL. CONTR., R108 22K, C111 .022, W104, R110 B 2.5 MEG. TONE CONTR., W105, C118 4700, LL, HH, C113 .0047, C112 270, FF, R288 47, C116 90 MF., C225 B 40 MF., C117 A 80 MF., -20 V., -20 V., +380 V., R114 470

PICTURE I-F

R319 560, W101, C102 25-280, C119 22, C120 22, L101 39.75 MC TRAP, L102 47.25 MC TRAP, 41.25 MC TRAP, C121 56

T104 1ST. PIX. I-F TRANS., V107A 6AZ8 1ST. PIX. I-F AMPL., R116 4700, R117 68, C122 1000, R115 1000, C124 330, C123 1000, R118 1000, L103

T105 2ND. PIX. I-F TRANS., R119 100 K, C125 1000

V108A 6AZ8 2ND. PIX. I-F AMPL., R120 1000, R121 68, C126 1000, R122 100 K, C127 330, R123 1000, C193 1000, L104

T106 3RD. PIX. I-F TRANS., C129 1000, R124 180

V109A 6AN8 3RD. PIX. I-F AMPL., C130 330, R125 470, C128 1000, C233 1000

T107 4TH. PIX. I-F TRANS., CR 101 1N60 2ND. DET., C131 5.6, L105 62 MU-H, R126 3300, L106 180 MU-H, L107 12 MU-H

R320 10 K, R321 10 K, +285 V.

PC 102-A

A.G.C. - SYNC.

V119A 6U8 A.G.C. AMPL., C173 56, R162 22K, R183 27K, R184 47K, R187 33K, +119 V., +140 V., R186 A 500 K A.G.C., +285 V., +285 V., +285 V.

R197 100 K, W106, R201 120 K, C182 .047, C183 .0022, R198 18K, R202 1 MEG., C185 0.33, R188 270K, R186 B 2.5 MEG. NOISE THRESHOLD

R200 33 K, R199 150 K, C184 0.47, R203 3.3 MEG., R190 470 K, C176 .01

V101B 6U8 NOISE INVERTER, +106 V., -8 V., +2.9 V., PC 101-B

R196 18 K, C181 0.1, R204 270 K, C186 330, R185 330

V109B 6AN8 1ST. SYNC. AMPL., R205 1.5 MEG., C187 330, R206 1.5 MEG., -45 V., +25 V.

V108B 6AZ8 2ND. SYNC AMPL., C188 0.1, R208 1 MEG., R209 33 K, R207 2.2 MEG., +45 V., -0.6 V., +25 V., R210 27K, C179 .0047, R212 5600, C180 .027, R211 8200, C189 .0047, R213 2700, PC 102-B

+285 V., C244 56, R299 8200, C174 470

LOW VOLTAGE POWER SUPPLY

S101 ON-OFF SW. (ON R107), BLK, RED, T117, F104 4.5A., SR 102 RECT., SR 101 RECT., GRN-RED, C224 200 MF., C225A 80 MF., C223 200 MF., L131 FILTER CHOKE, R266 500, +380 V., C117 B 40 MF., +285 V., -20 V., C117 C 500 MF.

R264 56 K, R265 56 K, S102 INTERLOCK, 115 V. 60~ SUPPLY

BLK-BRN, F102, F103, 6.3 V., BRN, BLU, TO DAMPER, BLU-YEL, +380 V., GRN, 6.3 V., TO KINE, & SH. REGUL., GRN-ORN, +285 V., R301 10 K

R268 100, R269 100, R267 1500 VERT. CENTERING, RED YEL, T116 VERTICAL CENTERING CHOKE, BLU GRN, C226 1000 MF. N.P.

HORIZONTAL OSCILLATOR - OUTPUT

C161 82, V117 6SN7-GTB HOR. SWEEP OSC. & CONTR., +285 V., -23 V., +4.9 V., +230 V., L118 HOR. FREQ., L119 HOR. SINE WAVE, R164 68 K, -86 V., R166 330 K, C160 .01, R165 3900, C159 0.47, R167 82 K, R169 820 K, C163 .047, R170 150 K, R168 100 K, R171 3.3 MEG., C156 270, C157 12, C162 82, C158 1000, R163 150 K, C155 .01, C154 .01, R158 39 K, R159 120, -70 V., V116 6CB5 HOR. SWEEP OUTPUT, +150 V., R161 150 K, R162 250 K HOR. DRIVE CONTR., R160 470 K, R157 56, R312 470, C152 0.22, C153 0.22, R156 11 K, -27 V., -20 V.

COMPOSI

V110 6CL6 1ST. VIDEO AMPL., +106 V., +2.7 V., C250 .001, R129 33, C132 3300, +4.1 V., 3-8 +118 V.

V119B 6U8 BURST KEYER, -20 V., R224 2.2 MEG., R300 3300, -43 V., C232 470, C192 .022, +280 V., C195 .01, +285 V., +140 V.

V122B 6AN8 REACT. TUB, R242 820, C201 2, R244 27K, C200 .01, R243 470, R245 47K, +3 V., +12 V., +38

HIGH VOLTAG FOCUS

T109 H-V TRANS., +100 V. U3, +50 V. U2, -70 V., W109, W1 W2 W3, YCT

COMPOSITE VIDEO – BANDPASS AMPLIFIER

T108 COLOR TAKE-OFF TRANS.

V121 B 6AZ8 BAND PASS AMPL.

T113 BAND PASS TRANS.

LUMINANCE AMPLIFIER

TD 101 DELAY LINE

V111 6CL6 2ND. VIDEO AMPL.

HOR. BLANKING

V122 A 6AN8 BLANKING AMPL.

KINESCOPE

V126 21AXP22 KINESCOPE

V119 B 6U8 BURST KEYER

T112 PHASE DET. TRANS.

V120 6AL5 PHASE DET.

V121 A 6AZ8 KILLER

DEMODULATION – PHASE INVERSION

V123 6AG7 DEMOD. DRIVER

T114 DEMOD. DRIVER TRANS.

V125 A 12BH7 "R-Y" DEMOD.

V124 B 6AZ8 "B-Y" AMPL.

V125 B 12BH7 "G-Y" DEMOD.

V122 B 6AN8 REACT. TUBE

V124 A 6AZ8 3.58 MC. OSC.

T115 3.58 MC. C.W. TR.

COLOR SYNCHRONIZATION

VOLTAGE FOCUS

V112 3B2 H.V. RECT.

V114 1X2B FOCUS RECT.

V115 6BL4 DAMPER

V113 6BK4 SHUNT REGUL.

PC 102-C

V107 B 6AZ8 VERT. OSC.

T111 VERT. OSC. TRANS.

VERT. OSCILLATOR OUTPUT

V118 6AQ5 VERT. OUTPUT

T110 VERT. OUTPUT TRANS.

CONVERGENCE

L120 VERT. CONV. CHOKE

J102-F REAR VIEW

J101-F REAR VIEW

P101-M PIN VIEW

DEFLECTION YOKE

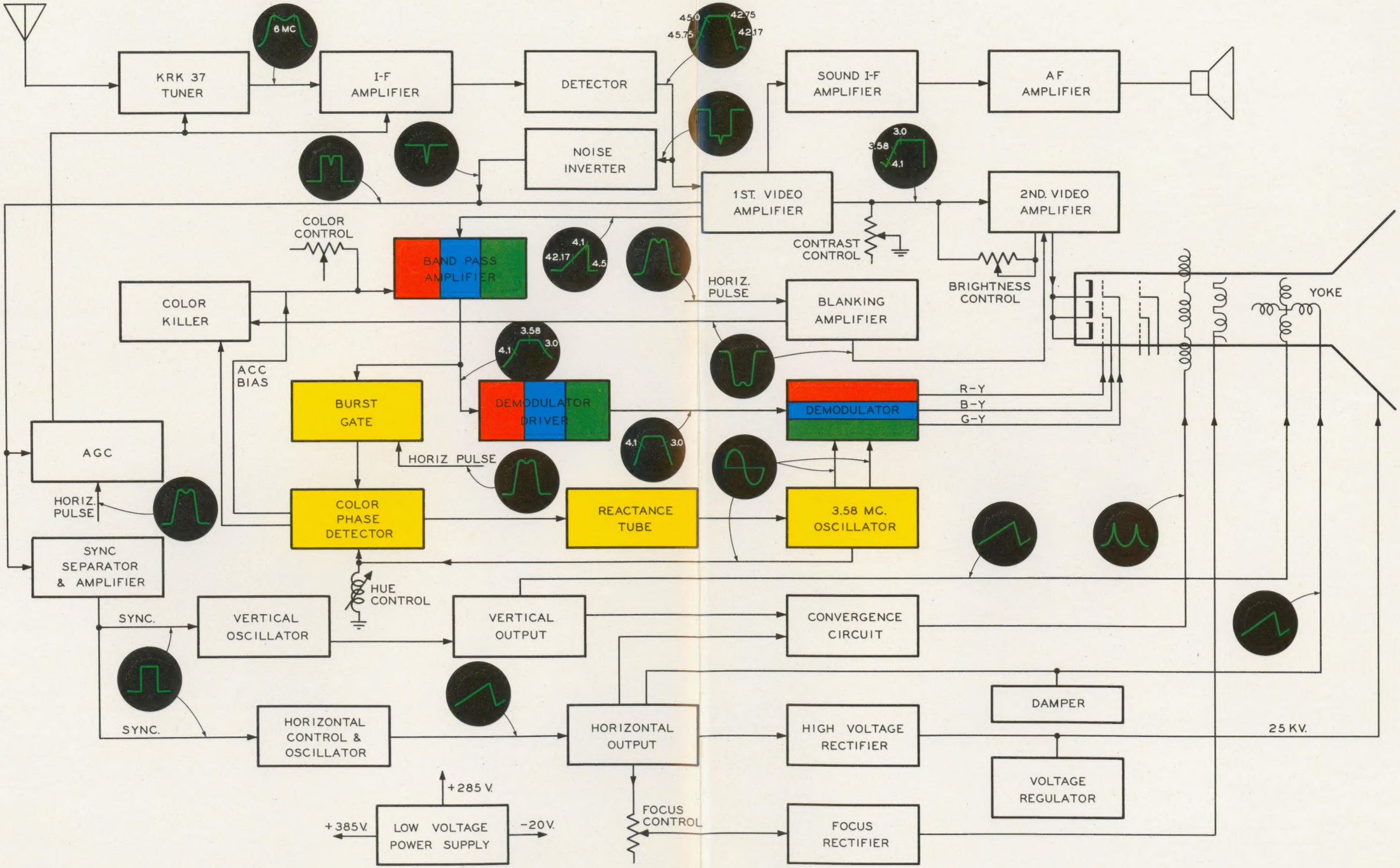
P102-M PIN VIEW

CONVERGENCE YOKE ASSEMBLY

CHANNEL IND. LAMP

EE-139 093-0

BLOCK DIAGRAM OF THE 21CT662 COLOR TELEVISION RECEIVER



RCA